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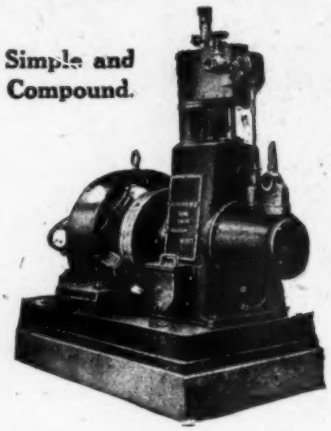

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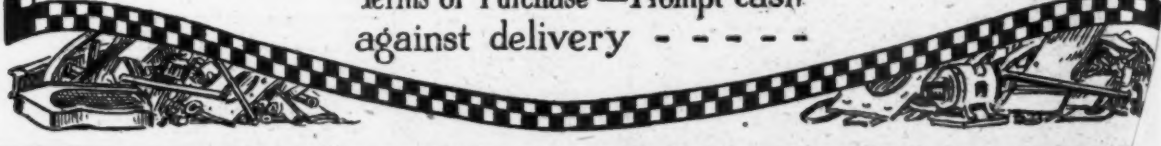

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ELECTRICAL REVIEW.

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FOREIGN TRADE EXPANSION.

THE Prime Minister has now delivered his speech disclosing the ideas of the Government in regard to trade, nationalisation of mines, Labour and Capital, reduced production, and many other subjects. During the recess, members of Parliament and the public will have time to consider the suggestions that have been advanced. The import restrictions of war-time come to an end on September 1st. It is anticipated that this will do something to bring down prices in certain classes, but the rate of exchange is expected to act as an effective wall preventing the excessive importation of American goods for some time to come. Measures are to be submitted to Parliament for protecting our industries against "dumping," and the interests of certain key-industries are to be safeguarded by prohibition of imports of their classes save under licence. Financial assistance is to be put at the disposal of exporters who wish to take part in the restoration of trade with the disorganised parts of Europe where we used formerly to do large business. The encouragement of technical instruction and industrial research and invention is recognised as a vital part of essential trade policy, while the Premier also looks for great good to follow from electric power development, the utilisation of water power, and the improvement of means of communication as a means of fostering Imperial trade.

There will be opportunity for dealing with these and the other matters referred to during the next month or two. This week we wish to mention several matters bearing upon foreign and Colonial trade development that have been brought somewhat prominently under our notice during recent months.

While the war was raging many engineers and engineering traders from afar came home to Britain to help in the successful conduct of munition and military operations. Their labours ended, they are returning filled with pride at the increased British manufacturing capacity that they will henceforth count upon as a tower of strength as they resume trading and technical operations in their normal spheres; but that pride in capacity as represented by size of works and more efficient equipment, is tempered with first-hand knowledge of industrial disturbance and with anxiety concerning whether the present signs that it has worn itself out are reliable; in some cases—we hope they are exceptional—they will return hopelessly dumbfounded with the apathy of certain manufacturers that they have come across regarding export trade necessities.

But while the ships pass outward with these, other vessels are bringing home men who have been in the foreign and Colonial fields holding the British commercial connection together during the war against great odds. It has been our privilege to meet a number of such men from China, from Canada, from India, from Australia, from Africa, and from Spain, during the past few months. They are full of energetic criticism and urgent counsel, and they ask many questions from which emerges strong suspicion that we are not making adequate efforts to take full advantage of the favourable opportunity that presents itself on grounds of sentiment, or to meet the fiercest world competition that has ever raged in regard to suitability and price.

We suppose that there are few British electrical or engineering manufacturers who would not sit down quickly and affix their signatures to any appeal in favour of British Trade expansion, notwithstanding the present crowded condition of some order-books. But it will hardly be consistently following out that burning aspiration if in practice, or through a policy of *doing* nothing, we throw business into the arms of neutral or former enemy countries. Unfortu-

THE INSTITUTION OF ELECTRICAL ENGINEERS.

Presidential Address to Irish Territorial Centre.

Mr. C. H. Wordingham, C.B.E., President, delivered his address to the Irish Centre at Dublin, on May 19th, and at Belfast on May 20th last. The following is an abstract of the address, which consisted mainly of a paraphrase of the Electricity (Supply) Bill.*

The Dublin Local Section, or as it is now called the Irish Territorial Centre, was founded in December, 1899, and it was one of the four first to be formed. A request was recently received by the Council to establish another Centre in Belfast, and I therefore visit Ireland to ascertain the feeling of members on the spot. The most suitable course would be to form a Sub-Centre in Belfast now, altering it to a main Centre if and when the numbers belonging to it justify such a course.

The electrical industry is to-day at the parting of the ways. It has often been stated in the past that the industry is in its infancy, but all must admit that it is now adolescent, and, like the common run of adolescents, it is contemplating matrimony, that is to say, marriage with the State. Like all marriages this is a leap in the dark, and no one can say with confidence how the match will turn out. In any case the freedom of private enterprise will to some extent, at all events, be exchanged for marital control. No more flights into the realms of fancy are to be allowed it; uniformity is to be attained everywhere, and every advance must be an advance as a whole; consequently such advance must be slow, and cannot be lightly undertaken. I am among those who, notwithstanding the possibilities of danger, hope for the best. It is unquestionably a great gain for Parliament to have awakened to the supreme importance of a cheap supply of electrical energy, and one must be gratified to know that the recently produced Electricity (Supply) Bill has been framed largely on the lines of a report presented to the Board of Trade by a thoroughly competitive and representative committee which obtained evidence from all quarters likely to be well informed on the subject.

One of the main features of the new Bill is the setting up by the Electricity Commissioners of District Electricity Boards. If a station is so small or so situated or equipped that it could not be conveniently used by the Board, the Board may be exempted from any obligation to purchase it. It is not quite clear what will then happen to the unfortunate little station which is unwanted, except that an opportunity will be given for a respectful hearing of its despairing wail.

The way in which the price of a generating station or main transmission line is to be arrived at is carefully set out in the Bill, and is free from a defect in the original report of the committee to the Board of Trade, inasmuch as it does not place at a disadvantage those undertakings which have made proper provision for depreciation as compared with those that have not. The Board has to undertake to supply the dispossessed authority with energy in quantities not less abundant and at prices not less favourable than would have obtained had it continued in possession of its property, and (this is very important) carried out improvements which it was at the time contemplating. This proviso is very fair, but one can see possibilities of a good many tussles in connection with it.

District Boards will be invested with very wide powers, and, where established, the whole of the electricity supply in the future will be in their hands.

An important point is the compensation for those officers or servants of the transferred undertakings who have suffered loss of employment or diminution of salary or wages by the transference. The payment of such compensation is not permissive, but is mandatory, and this is a most important improvement on the recommendations of the report on which the Bill is founded.

The second portion of the Bill deals with what are called transitory provisions, and some of these are very important.

Important powers in regard to wayleaves are given to the District Boards and to authorised undertakers, and the Boards are invested with the power to let on hire electric lines, fittings, apparatus, and appliances for lighting, heating, and motive power, and all other purposes for which electricity can or may be used. This is a most important right, the absence of which has pressed very hardly on local authorities.

The prices to be charged by the District Boards are to be subject to the approval of the Electricity Commissioners, and they are to be so fixed that the undertaking is not conducted at a loss. I may here call attention to a fallacy underlying this and an earlier portion of the Bill, viz., the assumption that in order to make a profit one has only to raise the price to the consumer. All experience goes to show that this is far from being true, on the contrary, most often the lowering of the price brings about the desired effect.

A word of warning, addressed rather to the public at large than to technical engineers, may be uttered against the extravagant hopes as to the extent of the reduction in price to the consumer that may be anticipated. It must not be forgotten that the saving expected is to be made on generation only, and that the distribution charges will remain practically unaltered; hence the percentage saving made is effected on a fraction, and not on the whole cost, and the price to the consumer will therefore be much higher than that commonly spoken of in connection with the cost of generation. A notable feature of the future, however, will probably be a great reduction in the discrepancy between the prices charged in different, and often adjacent, districts.

The Boards are given powers to borrow money for work the cost of which ought, in the opinion of the Commissioners, to be spread over a term of years including—and this is a most important provision—the payment of interest on money borrowed for capital expenditure whilst the expenditure remains unremunerative.

A radical change is about to be made in the conditions governing electric supply in Great Britain. The concentration of the legislative control in the hands of a single body the members of which will presumably be chiefly technical experts highly skilled in the problems with which they have to deal is a gain, the importance of which it is impossible to overestimate. The powers conferred upon these Commissioners are such as will enable them to control the design of the generating stations and transmission and distribution systems which are to be built in future, and gradually to eliminate those which do not conform with the general scheme. The day of the small and inefficient undertaking is about to pass, and we may look forward to electrical generation on the grand scale, with stations on sites enabling generation to be carried out on the most economical lines. The main danger to be guarded against is a tendency to carry uniformity of system too far, or to ride to death the idea of very large stations, or, as they have been not too happily named, "super-stations." There are still areas in which it may pay better to put down a small isolated station on a site not ideal rather than to insist upon the supply being taken from an economical generating station unduly far off. If the right men are chosen, however, they will realise this, and will not be unduly autocratic nor too closely wedded to preconceived ideas.

The powers given to the Commissioners for the carrying out of investigations with a view to improvement in practice are also of great value. It is true that the colossal scale on which any alteration in practice that may be determined on will have to be made will tend to deter the Commissioners from launching out into other than well tried improvements, and this may mean a certain amount of backwardness as compared with experiments made by individual enterprise, but it is to be hoped that means of avoiding this danger may be found.

The vesting of the carrying out of the supply in the hands of a district board is an experiment which may well give rise to a good deal of speculation as to the results. The district board would probably function very much in the same way as a municipal committee, but it would probably be larger than an ordinary electricity committee of a Corporation, and the introduction of large consumers and of labour may tend to weight being given to considerations which are very far removed from those making for the technical and commercial success of the undertaking. Like all constitutions the success or failure of the scheme must depend ultimately upon the individuals in whom the administration is vested, and one can only hope that the organisation proposed will be for the good of the industry.

The Bill, whatever its defects, if defects there be, is clearly an honest attempt to improve materially the position of the electric supply industry in this country; it has been framed on advice given after the fullest consultation with members of the industry itself, and its actual drafting has been with the aid of the highest technical advice obtainable. More than this we cannot ask, and it rests with every member of the industry to do his utmost to make the scheme work and the industry thrive.

There can be little doubt that with the abundant supply of energy which should shortly be available, the applications of electricity to industrial purposes and everyday domestic life will be largely augmented, and a great stimulus should be given to electrical manufactures of all kinds.

An important feature of the developments contemplated is the utilisation of sources of energy now running to waste, and the pressing into service of all available energy. Attention has been directed chiefly to the utilisation of blast furnace gas, and this will no doubt be one of the principal sources of waste energy, but we must not overlook the water power which now runs to waste, and which, though not concentrated in any great quantity at any one place, is in the aggregate of considerable magnitude. Already a scheme has been prepared for utilising the power inherent in the water which falls on Dartmoor, and there should be great opportunities for development in this direction in Ireland. The water power problem is greatly facilitated when worked in conjunction with large steam driven stations, and all sources feed into a common supply system. In Ireland there are

* Elec. Rev., May 16th, 1919, p. 559.

also great possibilities in the direction of the utilisation of peat for fuel.

In the great development to which we are looking forward we may well ask what part is the Institution of Electrical Engineers going to play. Already it has done a large amount of useful work for the industry, and it is unquestionably a living force. If, however, it is to effect anything like the amount of good of which it is capable it is essential that it should be given wider and more effectual powers. Of late, however, the Institution has taken a larger hand in industrial matters, and while not actually entering the commercial field it has afforded facilities to organisations whose objects are chiefly commercial for meeting under its auspices jointly with its own representatives, and in some cases it has been instrumental in the formation of new associations having commercial objects and the protection of the material interests of those constituting its membership.

In my judgment it is absolutely essential if the electrical industry is to rise to the heights of which it is capable that there should be one and only one representative body able to speak in the name of the entire industry. Such a body could readily be formed by the expansion and development of the Institution as we now know it. I have recently described in outline a scheme in accordance with which these objects could, I think, conveniently and practicably be effected. I hope that all members of the Institution will do me the honour of reading that address,* and that the Irish section will give an opportunity to its members of discussing the proposals which I have outlined.

I have only been able in the time at my disposal to give an extremely brief sketch of the future, whether in regard to the prospects of the industry or of the part to be played by the Institution, but I hope I have shown that great developments may be confidently anticipated, and that the community at large has much to hope for and to gain by the prosperity of the electrical industry.

AN ELECTRICALLY-DRIVEN TUBE MILL.

Several points of interest arise in connection with an installation of electrical plant, recently carried out by the General Electric Co., Ltd., at the tube works of the Talbot Stead Tube Co., of Birchills, near Walsall. The principal feature is the direct driving of two Pilger mills by a motor running at the speed of the mill, and driving without a flywheel. This is the first time that electric motors have been so used in Great Britain for Pilger mill driving; in fact, it is believed to be the first time that a Pilger mill has been electrically driven at all. In a Pilger mill there is a severe shock once every revolution, extending over about one-third of a revolution, when the rolls grip the tube. Accordingly, special attention had to be paid to the design of the motors. "Witton" D.C. machines were adopted, the voltage on which they run being 440. The normal full load of each is 188 H.P. at a speed of from 100 to 200 R.P.M. The speed drop between no load and full load is guaranteed to be not more than 10 per cent. at 100 R.P.M. and not more than 20 per cent. at 200

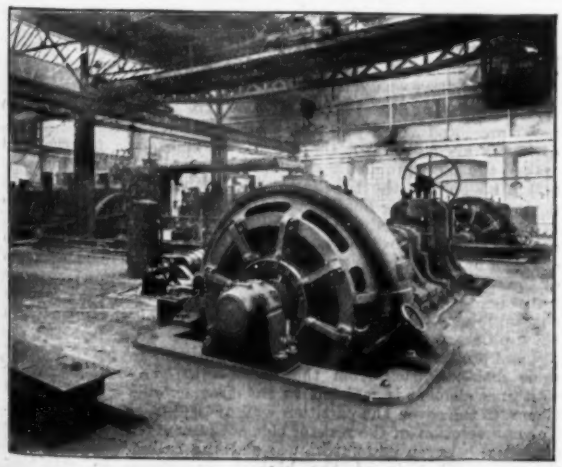

Fig. 1.—"Witton" 188-H.P. Motor Driving the Pilger Mill.

R.P.M. Further, the motor is able to stand up to a peak load of 400 H.P. for one minute at any speed within its working range. In addition to being fitted with interpoles, complete compensation is provided so that full output can be obtained at the most suitable speed for the size of tube in the mill. The shunt regulator for controlling the speed is placed near the motors in a locked case, to which the charge hand alone has access.

* Elec. Rev., May 30th, 1919, p. 623.

The special features which had to be introduced into the design in order to enable the motor satisfactorily to withstand the heavy shocks thrown upon it due to the absence of a flywheel include the provision of a very heavy shaft and low centre bearings, to enable them to withstand the "shock." The beds are also sunk in the ground, and the spider carrying the commutator is carried on an extension of the armature spider, to which it is fastened with two heavy keys. One of the motors is seen in fig. 1.

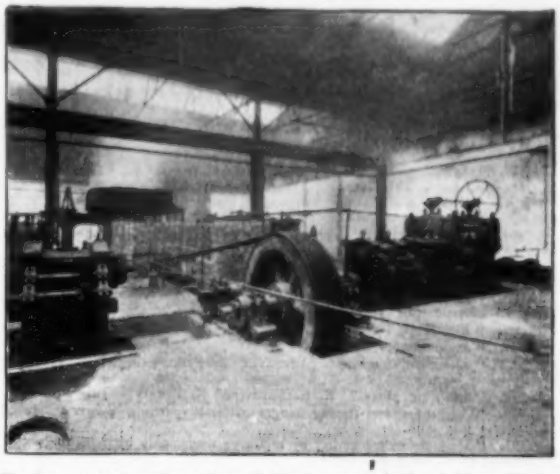

Fig. 2.—"Witton" 300-H.P. Motor and Rope Drive for the Finishing Mill.

Before the billets reach the Pilger mill they are passed through a piercer driven by a 300-H.P. three-phase "Witton" induction motor of the three-bearing type, driving the piercer flywheel through a rope drive. A duplicate motor with a similar drive is used for the rolling mill, which finishes the tubes to gauge. This is illustrated in fig. 2. With both these motors it was considered desirable to allow for a certain amount of slip, and an automatic slip regulator of the eddy-current control type was installed. This automatic regulator is also used for starting.

Power is obtained in the first instance from the three-phase 6,600-volt 50-cycle mains of the Walsall Corporation. This is transformed down, and, where possible, transmitted to various constant-speed motors, but for the Pilger mills a D.C. supply is required. To obtain this a 500-KW. rotary converter has been installed. This is a six-phase interpole machine of the standard "Witton" self-synchronising type.

The starting of the motors is in the hands of the operator in the rotary sub-station, which is situated at a considerable distance from the mill. Should the circuit breaker open due to an overload, a bell is rung in the sub-station and the attendant immediately closes the breaker. However, if the stoppage is intentional and for safety, there is push-button apparatus in various parts of the shop; a red light is shown on the switchboard, and the attendant is thus informed that he should not close the breaker until he receives the necessary instructions. Electric motors are extensively used at these works for driving hot saws, compressors and other auxiliary machinery.

The Channel Tunnel.—The Committee appointed by the French Minister of Public Works to study all questions relating to the Channel Tunnel, has finished its examination. Findings favouring the executing of the project have been adopted by the Council of Public Works and by the French Military Delegation. The Ministry of Public Works has authorised the formation of a French underground railway company to undertake experiments for new technical methods of tunnelling. The Committee asks M. Pichon to suggest to the British Government the formation of a Franco-British Committee to draw up the necessary agreement for regulations connected with the tunnel. It also asks that the British Government should obtain ratification of the agreement by the House of Commons.

Low-Temperature Carbonisation.—One of the chief drawbacks to the carbonisation of coal at low temperatures is the production of a semi-coke that is not hard and dense enough to stand transportation without disintegration. In a letter to *The Times* of July 29th, Lieut.-Col. Herman Clarke, C.B.E., R.E., describes the Summers patent process, which has been in successful operation in America for the past five years. In this system continuous operation is effected by aid of a reciprocating floor to the horizontal over, which by its motion longitudinally discharges the coke at one end and draws coal from the bunker at the other; at the same time, the plastic coal in the oven is heavily compressed by the movement of the floor, and the solid product is a hard dense smokeless fuel, while a high yield of by-products is recovered. The process is rapid and economical, and will shortly be demonstrated in this country.

NEW PATENTS APPLIED FOR, 1919.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs Sefton-Jones, O'Dell and Stephens (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

18,634. "Thermionic valves." L. A. McDougald. July 28th.

18,663. "Alternating current motors and rectifiers." L. B. Miller. July 28th.

18,665. "Means for adjusting timing of magnetos." A. H. H. Davies and H. R. H. Davies. July 28th.

18,678. "Electric lighting of machines driven by electric motors." V. Hope. July 28th.

18,683. "Thermostatic valve units." British Thomson-Houston Co. (General Electric Co.) July 28th.

18,734. "High-tension apparatus for hot cathode X-ray tubes, &c." A. C. Gunstone. July 29th.

18,760. "Electrically heated hot plates." F. P. Fletcher. July 29th.

18,787. "Double pole switches and fuse boards." G. H. Godsehere. July 29th.

18,797-8. "Cooling electric machinery transformers, &c." H. A. Camey and H. M. Lacey. July 29th.

18,801. "Means for making temporary connections with electric supply cables." J. H. Collie. July 29th.

18,803. "Portable electric lamps and means for generating current therefor." P. Cohn, Merrell's and D. Spurling. July 29th.

18,809. "Dynamo electric machines, &c." L. H. R. de Parmelaire. July 29th. (France, September 19th, 1918.)

18,829. "High-frequency signalling systems." Western Electric Co. (Western Electric Co.) July 29th.

18,860. "Electric switches." E. J. Harman and E. Le Bas. July 29th.

18,941. "Accumulators, &c." D. Fuller. July 29th.

18,863. "Electrically operated automatic reversible turnstiles." R. E. Wood July 30th.

18,873. "Sparking plugs." E. E. Bates and E. Perkins. July 30th.

18,879. "Apparatus for testing magnetos and sparking plugs." J. M. Tumelty. July 30th.

18,891. "Magneto motor acting by repulsive movements between the poles." D. Suchostawer. July 30th.

18,896. "Electric heating devices and methods for making same." British Thomson-Houston Co. (General Electric Co.) July 30th.

18,910. "Electric lamps for vehicles." Fullers United Electric Works and A. P. Welch. July 30th.

18,918. "Electrical heating elements." E. J. Hazelton. July 30th.

18,928. "Incandescent electric lamps." L. A. De Becker. July 30th.

18,920. "Device for holding shades on bayonet electric lamp-holders." R. S. Atherstone. July 30th.

18,930-1. "Manufacture of electric batteries." R. S. Atherstone. July 30th.

18,932. "Storing electricity from variable power." W. P. Perry. July 30th.

18,933. "Method of indirectly coupling a radio-telegraphic antenna to high-frequency transformer." J. Bethenod. July 30th. (France, July 30th, 1918.)

18,941. "Sparking plugs." D. V. L. Fellows. July 30th.

18,942. "Dynamo electric motors." W. H. Glasser. July 30th.

18,950. "Magnetos." G. M. Turner. July 31st.

18,960. "Sparking plug." F. G. F. Hinton. July 31st.

18,963. "Electrical switches." W. Sparks and W. H. Tonks. July 31st.

18,964. "Electric heating apparatus." C. H. Archer, Automatic Telephone Manufacturing Co., and G. W. Simister. July 31st.

18,965. "Amplifiers for telephone circuits, wireless telegraphy, &c." K. E. Edgeworth. July 31st.

18,975. "Electric motors." A. Heurtebise. July 31st.

18,985. "Measured service telephone systems." Automatic Telephone Manufacturing Co. July 31st. (United States, February 12th.)

18,999. "Variable electrical condensers." J. Joseph and H. W. Sullivan. July 31st.

19,005. "Manufacture of carbon electrodes." E. C. R. Marks. (Soc. Anon. Italiana G. Ansaldo & Co.) July 31st.

19,014. "Electric lamps for vehicles." R. F. Rowe. July 31st.

19,042. "Obtaining alternating currents from existing three-phase systems." A. M. Taylor. August 1st.

19,056. "Electric heaters." British Thomson-Houston Co. (General Electric Co.) August 1st.

19,062. "Electric cut-outs." E. A. Lamkin. August 1st.

19,083. "Electrodes for welding, &c." H. D. Lloyd, Whitecross Co., and W. W. Wilson. August 1st.

19,088. "Distributors for magneto generators." E. C. R. Marks. (Splitdorf Electric Co.) August 1st.

19,102. "Electric switches." A. Pouchain. August 1st. (Italy, August 14th, 1918.)

19,108. "Means for starting internal-combustion engines adapted also for generating electric current." W. S. Jeal. August 1st.

19,109. "Portable electric cooker box." A. A. Hunt. August 1st.

19,110. "Telephone receivers." W. A. Jackson and Telephone Manufacturing Co. August 1st.

19,143. "Electro-magnetic apparatus." D. Cook. August 2nd.

19,167. "Magnetic cores with electric windings." W. A. A. Burgess. August 2nd.

19,172. "Electro-thermostat." J. A. Abbott. August 2nd.

19,182. "Shades, &c., for electric lamps." T. Phillips. August 2nd.

19,185. "Sparking plugs." W. A. Clark, H. G. Longford, W. W. Longford and Sphinx Manufacturing Co. August 2nd.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1917.

14,350. Electric transforming and converting apparatus. British Thomson-Houston Co. ((General Electric Co.) October 4th, 1917. (129,304.)

14,560. Circuit breakers for ignition apparatus. Remy Electric Co. November 10th, 1916. (129,309.)

14,652. Methods and apparatus for the amplification of small currents by electron discharge relays. British Thomson-Houston Co. (General Electric Co.) October 10th, 1917. (129,313.)

15,464. Aerial circuits for wireless telegraphy and other purposes. R. A. W. Watt. October 24th, 1917. (129,336.)

15,514. Electrical make-and-break contact. J. H. Potts. October 25th, 1917. (129,339.)

15,610. Wireless signalling systems. J. H. Rogers and H. H. Lyon. November 10th, 1916. (129,346.)

15,670. Electrical regulating apparatus. B. Davies, W. Judd and Eastern Telegraph Co. October 27th, 1917. (129,348.)

15,774. Electric arc lamps. A. H. Railing and A. E. Angold. October 30th, 1917. (129,355.)

15,888. Electrodes for electric arc welding. E. Languepin. October 31st, 1917. (129,360.)

16,021. Sound detectors. Western Electric Co., G. H. Nash, G. E. R. Penny, B. B. Grace and R. A. Mack. November 2nd, 1917. (129,364.)

16,054. Electrical heater. C. G. Nobbs and Falkirk Iron Co. November 3rd, 1917. (129,366.)

16,276. Electric regulating switches for use with ordnance and for other purposes. J. S. Wilson, W. E. Dalby, and Armstrong, Whitworth & Co. (129,373.)

1918.

7,711. Telephone systems. Western Electric Co. ((Western Electric Co.) May 8th, 1918. (129,397.)

9,115. Conversion of electric currents. C. N. Bennett and A. Lyon & Wrench. December 19th, 1918. (129,400.)

9,453. Electric heating apparatus for liquids. R. C. Watson. June 8th, 1918. (129,406.)

9,469. Electrically heated crucibles, melting pots, and the like. Morgan Crucible Co. and C. W. Speirs. June 8th, 1918. (129,407.)

10,799. Liquid electrical resistances. G. Dearle. July 2nd, 1918. (129,414.)

11,181. Electric batteries. L. Rabinovitch and A. Mond. July 8th, 1918. (129,423.)

11,197. Electric accumulators. S. J. Williams. July 8th, 1918. (129,425.)

11,304. Electric heating apparatus. H. J. C. Forrester. (H. Burgess.) July 10th, 1918. (129,438.)

11,336. Electric lamp switches. E. C. Leachman. July 10th, 1918. (129,440.)

11,444. Electric locomotives or cars. British Thomson-Houston Co. (General Electric Co.) July 12th, 1918. (129,449.)

11,868. Ignition sparking-plugs for internal-combustion engines. F. L. Rapson. July 20th, 1918. (Cognate application 12,480/18.) (129,467.)

12,877. Measuring and controlling electric power. British Thomson-Houston Co. (General Electric Co.) August 8th, 1918. (129,487.)

12,960. Electrolytic method of cleaning iron of steel. Q. Marino. August 9th, 1918. (129,489.)

13,455. Hammer interrupters for radiotelegraphy. Svenska Aktiebolaget Gasaccumulator. September 14th, 1917. (120,198.)

13,583. Magneto-electric machines for ignition in internal-combustion engines. British L.M. Ericsson Mnfg. Co. and A. Brookes. August 21st, 1918. (129,500.)

14,738. Terminal fittings of incandescent electric lamp-holders. G. F. Colson. September 11th, 1918. (129,511.)

14,767. Means for securing shades to the holders of electric lamps. H. F. Wheeler. September 11th, 1918. (Patent of addition not granted.) (129,512.)

14,917. Temperature indicators for transformers and the like. British Thomson-Houston Co. (General Electric Co.) September 13th, 1918. (129,515.)

15,868. Electric incandescent lamps. British Thomson-Houston Co. (General Electric Co.) September 30th, 1918. (129,524.)

19,468. Means for supporting the shade of an electric incandescent lamp. L. G. Flory. November 26th, 1918. (129,547.)

21,628. Apparatus for electric welding. T. E. Murray and J. B. Murray. March 19th, 1918. (124,188.)

21,779. Call-indicator for telephone systems employing automatic switching apparatus. Automatic Telephone Mnfg. Co. (Automatic Electric Co.) December 30th, 1918. (129,563.)

1919.

1,133. Sparking plugs for electrical ignition systems. A. Ogden. January 16th, 1919. (129,568.)

2,751. Electric wave meters. J. S. E. Townsend. February 4th, 1919. (129,579.)

4,542. Sparking plug. A. Sproul. February 24th, 1919. (129,591.)

5,057. Portable electric lamps. H. Dean and Chloride Electrical Storage Co. February 28th, 1919. (129,595.)

Heating Ingots Electrically.—Mr. T. F. Baily, in a paper presented recently to the American Iron and Steel Institute, expresses his belief that the electric soaking pit is, for the steel maker, the most promising development of the electric furnace; and in his opinion the time is not far distant when practically all modern mills rolling hot ingots will be using electric pits. This type of pit will eliminate the roll breakages due to cold ingots, delays occasioned by unevenly-heated ingots, and oxidation. To ensure a uniform temperature, the heating should be done by means of the walls of the pit rather than by direct radiation from the resistance elements. The latter, composed of broken carbon thrown loosely into a carborundum, fire-sand trough, supported on brick pillars, are located along the outer wall of each side of the pit, and protected against injury from the ingot by being recessed some distance back from the ingot cell. The heat from the resistance element is radiated to the circular wall of the pit, and thence to the cover, the partition wall of the pit, and to the ingots. The cross-section of the resistor element is such that there is little difference between its temperature and the ruling temperature of the pit. What is of the highest importance in obtaining uniformity of heating is that most of the heating is done by the walls of the pit rather than by direct radiation from the resistor element.—*Technical Supplement to the Review of the Foreign Press*

The X-Ray Examination of Materials.—In an article under this heading, the *American Machinist* of August 2nd gives a detailed account of the technique involved in examination of materials with the X-rays; the apparatus is described, and the numerous precautions which are necessary to prevent fogging by the production of secondary rays, and undue distortion of the image, are explained. The article is based upon the practice of Messrs. Harry W. Cox & Co.

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ELECTRICAL REVIEW.

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The "Electrical Review" Table of Pre-war and Present Prices of Electrical Energy for Lighting, Power, Heating and Cooking, and Traction, and Cost of Coal, in 240 British Electricity Supply Undertakings, is now ready.

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FOREIGN TRADE EXPANSION.

THE Prime Minister has now delivered his speech disclosing the ideas of the Government in regard to trade, nationalisation of mines, Labour and Capital, reduced production, and many other subjects. During the recess, members of Parliament and the public will have time to consider the suggestions that have been advanced. The import restrictions of war-time come to an end on September 1st. It is anticipated that this will do something to bring down prices in certain classes, but the rate of exchange is expected to act as an effective wall preventing the excessive importation of American goods for some time to come. Measures are to be submitted to Parliament for protecting our industries against "dumping," and the interests of certain key-industries are to be safeguarded by prohibition of imports of their classes save under licence. Financial assistance is to be put at the disposal of exporters who wish to take part in the restoration of trade with the disorganised parts of Europe where we used formerly to do large business. The encouragement of technical instruction and industrial research and invention is recognised as a vital part of essential trade policy, while the Premier also looks for great good to follow from electric power development, the utilisation of water power, and the improvement of means of communication as a means of fostering Imperial trade.

There will be opportunity for dealing with these and the other matters referred to during the next month or two. This week we wish to mention several matters bearing upon foreign and Colonial trade development that have been brought somewhat prominently under our notice during recent months.

While the war was raging many engineers and engineering traders from afar came home to Britain to help in the successful conduct of munition and military operations. Their labours ended, they are returning filled with pride at the increased British manufacturing capacity that they will henceforth count upon as a tower of strength as they resume trading and technical operations in their normal spheres; but that pride in capacity as represented by size of works and more efficient equipment, is tempered with first-hand knowledge of industrial disturbance and with anxiety concerning whether the present signs that it has worn itself out are reliable; in some cases—we hope they are exceptional—they will return hopelessly dumbfounded with the apathy of certain manufacturers that they have come across regarding export trade necessities.

But while the ships pass outward with these, other vessels are bringing home men who have been in the foreign and Colonial fields holding the British commercial connection together during the war against great odds. It has been our privilege to meet a number of such men from China, from Canada, from India, from Australia, from Africa, and from Spain, during the past few months. They are full of energetic criticism and urgent counsel, and they ask many questions from which emerges strong suspicion that we are not making adequate efforts to take full advantage of the favourable opportunity that presents itself on grounds of sentiment, or to meet the fiercest world competition that has ever raged in regard to suitability and price.

We suppose that there are few British electrical or engineering manufacturers who would not sit down quickly and affix their signatures to any appeal in favour of British Trade expansion, notwithstanding the present crowded condition of some order-books. But it will hardly be consistently following out that burning aspiration if in practice, or through a policy of *doing* nothing, we throw business into the arms of neutral or former enemy countries. Unfortu-

nately, however, we have very definite evidence that that has been done—and not by any means in one case only. We hold no special brief for merchants, but if manufacturers cannot do business *direct* with foreign markets, they will surely be well advised to avail themselves of the services of merchants rather than let the business slip through into other countries for execution. We are perfectly well aware that in the past some British merchants have been only too willing to secure contracts under their own British names, and pass them on to German and neutral manufacturers who have quoted favourable terms and conditions. The British manufacturer is naturally disinclined to assist such firms, but there are times when it might be wiser to take a long view. Supposing the British manufacturer declines to have any dealings with the British merchant abroad—what happens? Sometimes, as in cases that have come directly under our notice, the said merchant has a connection that has taken scores of years to build up. He is known by buyers whom the manufacturer may never get to know, or only after long effort. If the British manufacturer will have "no truck" with him, it is not to be supposed that he will throw away his chance of doing trade; he will go to manufacturers of other countries who are ready all the time to avail themselves of his services and of his long-established connections. We are more interested in the prosperity of the British engineering manufacturer than in that of the British merchant who may have a more or less indifferent engineering department, but when there are brought under our notice actual cases of long-established merchants with expert knowledge of a particularly desirable market—such, for example, as the whole of South America—receiving the cold shoulder from our manufacturers in such a way that they are obliged to link themselves up with a big Continental manufacturer who will fill the orders for electrical machinery that they are able to secure in the course of their agents' tours, we think we are justified in stating the matter in this way directly in the interests of the British manufacturer himself. It seems preposterous, after all that has been said so emphatically and so bravely during five years, that it should be necessary for an English house to go out in search of trade definitely pledged to put in Continental plant, because either apathetically or through prejudice, he has been "turned down" or not replied to by British firms. We fear that we shall be bigger losers than we think if we have deferred our resumption of foreign trade activity because we were "too busy with war work," or because we could not tell what the Government policy was going to be, or because the attitude of labour was so menacing. Business, of course, could not be "as usual" during the last four years, but preparations for doing it need not have been so long deferred in *some cases*, and they certainly ought not to be any longer deferred in *any case* to-day. So much for South America—a market of infinite British electrical trade possibilities.

Now let us call the next evidence. Our witness? An expert British engineer from Canada—a market so often despised and rejected by British electrical men because Canada-is-so-American-you-know, and because of the contiguity of the States. He advances examples to show that, however close the sympathies between Canada and the U.S.A. may now be, they are not so close or so strong as are the sentiments of Canadians—whose prairie sons leaped to saddle and flocked across the seas so readily towards the Mother Country to help to fight the foe. He states emphatically, too, that, notwithstanding all the adverse factors so commonly quoted—price, distance, freight, delivery, design—as being against us, the British electrical manufacturer is fully capable of standing up against even the American manufacturer when he lays himself out to make what is desired. And he can do so, for particular lines, with a fair margin of profit, satisfactory to himself—and *has done so!* What one has done once in this way he can do again, and what he has done others, too, can do. Why? Partly because the American tenderer counts on the British manufacturer having thrown up the sponge as far as Canada is concerned, and he is, therefore, with a clear field, able to put in a very profitable price. Partly, because the Britisher is too often inclined in advance to regard as not worth while a change or departure from the beaten track, which, if he only made the practical attempt, would be found to be very much worth his while. We commend this criticism and suggestion—the outcome of practical experience—to the serious attention of all interested in the expansion of our electrical export trade. Our Colonies that give us preferential treatment are justified in looking to us to make the requisite effort, whether it be made in the works at home by adaptation for the production of *their* requirements, or in the market through well-organised branches, stores, and travellers.

From other of our friends we receive criticisms regarding our failure to carry sufficiently large stocks abroad—a point that we must leave for the moment though we have advanced it on several occasions during the war, showing how our shortcoming in this respect created just the opportunity that the British exporter of German wares made good use of in some places. We also hear things said about British representation abroad—another old subject. We should have supposed that the criticism had soaked right in long ago; indeed, we know that in some cases it has led to the dispatch of the best men available. But the world is wide, and the best men cannot be everywhere unless we get more of them. How can we do that? There are various ways. We must spare for a time some of those who seem so essential to our operations at home; men who know the business of their concern from A to Z, and can act with authority and knowledge. We can train others in our offices and works expressly to become foreign trade missionaries. We can do so if we hold out to them the hope of commensurate reward. We can bring the students of the foreign colleges home to England and equip them, and in other ways we can so prepare as to prove that we are not out merely for an immediate success but for a permanent prosperity.

We select this note of training men for the future as the one upon which to close this article. Some weeks ago we commended the scheme of the University of London for establishing Commerce Degrees, but space did not permit of our entering into the details of this admirable movement. We are disinclined to belittle the value of the "hard-headed man of business," who in the former days grew in power and influence as the result of hard knocks and practical experience, and whose head has been described, with scholastic scorn, as being so hard that one could hardly get anything into it. He did well for us, and there are great magnates in our businesses to-day, who are held up to our admiration as examples to follow, who have made their positions and fame by dint of hard work, sticking to it, and watching their opportunities. How much scientific and business training did they have? It was sheer force of character, resolution and determination, the ability to use the services of other men, the willingness to work hard and to induce others to do the same, that won many a man's way to fortune. True, they began in other times, when the conditions were different, when there was not the same international training and alertness in competition with them. Far be it from us, as a scientific trade journal, to undervalue science in business—we are too soundly convinced that technical qualifications in some measure are essential for electrical and engineering expansion agents abroad; our previous writings on that subject express our very serious convictions on that head. The University scheme for granting Commerce Degrees after a suitable course along the lines elaborated, is deserving of the fullest possible support. Our great City financial and other concerns have come forward with munificent gifts, and we trust that the response will come up to the requirements that have been announced, so that during the early months of autumn many men of suitable education will enter upon a course which must almost certainly lead them to a career of success in commerce as a great profession.

Scientifically-trained leaders of commerce we need to guide the destinies of our great industrial concerns in days of keen international competition, yet the school of practical experience will, in our opinion, always be affording men of natural unquenchable business spirit and enterprise plenty of scope for making their way in the world and bringing new credit to British commerce and industry. There are special spheres for both types.

American Electrical Competition in Scandinavia.

Since the time of the signature of the Armistice, American electrical firms have been busily occupied in endeavouring to promote the export of machines and apparatus to Scandinavian countries, whilst, on the other hand, firms, specially in Finland, have been seeking agencies for United States manufactures of all kinds, including electrical products. In the case of Scandinavia in general American firms, particularly in regard to electrical apparatus, have found themselves up against a big thing; and this big thing is German competition in Scandinavia, the adaptability of German firms to the particular requirements of Scandinavian customers in matters of detail, so that the latter even before the war became accustomed to the use of Teutonic manufactures which satisfied their needs, and are now again welcoming them in so far as the articles are not produced in the countries themselves. Moreover, the low rate of exchange for the German mark is in favour of the Teutonic firms and against the Americans, and a further obstacle in the way of the latter is that although some of them have been supplied with samples of German-made apparatus and accessories which please the Scandinavians, they were indisposed to produce the articles in the precise form which satisfies customers and the electrical regulations in points of detail. It seems that the American export policy, dealing with any particular article, is "Take it or leave it." If this practice is continued, and even when the German mark has appreciated, it is possible that the non-adaptability of American firms to the requirements in Scandinavia will be sufficient to check their enterprise. We draw attention to these facts in the hope that British firms who may intend to develop business in the markets in question may avoid the pitfall into which the Americans appear to have blundered through imagining that what is suitable for American customers is likely also to please the palate of nations on another continent thousands of miles away.

A Great Hydro-Electric Works Scheme in Italy.

The coal problem in Italy, which at all times has been a matter of difficulty if not concern, has now reached such a critical stage owing to international developments in coal-producing countries, that the Government finds it impossible any longer to withhold financial support to well-considered hydro-electric schemes so as to render the country less dependent in the future upon imports of coal for power purposes than has been the case hitherto. With this object in view, the Minister of Public Works, just before the Chamber adjourned last week for a short vacation, introduced a Bill which is intended to encourage the establishment of hydro-electric works, the erection of transmission lines, and the application of electricity to agriculture. As the existing hydro-electric works are inadequate for the purpose of producing power necessary for the development of a vast scheme of electrification, the Bill proposes to authorise the Government to grant subsidies so as to stimulate the creation of new works. In order, however, not to facilitate schemes, the execution of which would be onerous for the general economy, the subsidy will only cover one part of any scheme, namely, the generating works. It is intended, for instance, to make a grant of 40 lire (£1 12s. in normal times) per horse-power for the average nominal power developed by the works, and the subsidy will continue for 15 years. The criterion which has guided the fixing of this period is based upon the consideration that this term is sufficient, judging from works created before the war, for covering the interest on most of the capital employed in the works, and it is therefore maintained that the amount of the subsidy would be adequate for all works of real advantage to the national economy. If it is possible under the Bill to secure the execution of works representing 2,000,000 H.P., the State contribution will reach £3,200,000 per annum for a period of 15 years. It is considered that this sum cannot be regarded as too great having regard to the fact that the total plant in question would represent the equivalent of 8,000,000 tons of coal per annum.

A Parisian Supply Combination.

A scheme is being promoted in Paris with a view to the conclusion of an understanding between the various supply companies in the vicinity of the French capital. The idea is to concentrate the production of energy in the hands of the Compagnie Générale de Distribution d'Energie Electrique, which should not be confused with the supply monopoly in Paris itself—namely, the Compagnie Parisienne de Distribution. If the project were carried into effect, the Paris district companies would discontinue the operation of their generating works, which would be transferred to the Compagnie Générale, and would merely take a supply of energy from the latter for distribution to small consumers. It is stated that the proposal represents a revival of a pre-war scheme which had to be abandoned owing to the outbreak of hostilities. The transaction has been prepared by a small syndicate bearing the name of the Union Française d'Electricité, which is to absorb the before-mentioned Compagnie Générale de Distribution d'Energie Electrique. The latter, which carries on a supply station at Vitry-sur-Seine, and has recently started to install a second works at Billancourt, has hitherto sold energy in bulk to transport and distribution companies, and the company will continue this branch on a larger scale in the future.

What is an Essential?

There are always those who are anxious to establish life on an entirely utilitarian basis, who do not see why children should not begin to earn something at fourteen years of age, or earlier, who decline to accept as authentic any measurement that cannot be made with a pint pot, and who regard art, music, and literature as outside the scheme of practical politics. We had imagined that this was a characteristically hard-headed mental attitude which was only to be found in England, and in the Northern Counties at that. We find, however, that an American periodical contains an article by Mr. E. H. Fish, which is called "Non-Essentials of Engineering Education," and in which, after suggesting that the curricula of engineering schools look as if they were built to make the schools look like colleges, he ventures the opinion that there is no need for more than the most elementary training in mathematics, none at all for the calculus, none for languages, and none for any subject beyond "the point where the student can go alone."

Anything better than this standard is to form part of a post-graduate course, and most is to be learned from newspapers and magazines, though how anybody "educated" in such an incomplete manner will be able either to appreciate or to write an informative article is not explained.

Mr. Fish would have us go over the work of the engineering schools with a small-tooth comb, and take out anything not of immediate practical use. True, there is some stray indication that such non-engineering topics as he names should be taken by everyone, engineer or not; but as he seems to be quite uncertain whether they should form part of the elementary school work or the post-graduate courses, one is not able to extract much guidance from his suggestions.

Languages are not required, because America is a big place, and there are few parts of it where English is not understood, and even the American soldiers found they did not need more than a very limited knowledge of French. Why not? Because the French took the trouble to learn some English. Well, we have heard Englishmen say there is no need to go outside the limits of the British Empire to attain eminence in engineering; while, as the map is already well marked with red, anyone who wants to talk to an Englishman can learn our language instead of our learning his. But we are very glad to think that the British tendency, as we were able to show in a recent article, is towards a higher and better standard of general education. If, then, the tendency in America is in the direction indicated by Mr. Fish, the British outlook is even better than we had anticipated.

ELECTRICITY ON THE FARM.

The Eve of an Important Discovery.

By CHARLES MERCIER, M.D., F.R.C.P.

Electricity has many uses: its importance we are not likely to belittle, but it seems doubtful whether anyone of its many uses will be more important in the future than its use as a stimulant to the growth of farm crops, and as a preventive of fungous diseases.

A remarkable instance of the power of electricity on plant growth was exhibited the week before last by a crop on the farm of Mr. W. E. Pledge, Elmstead, near Ashford, in Kent, which was inspected by representatives of Wye College, of the *Times*, the *Morning Post*, and other important papers, and by Mr. Finlayson, the eminent fungologist, and others. The field, about eight acres in extent, had been sown in last October with red standard wheat, one-half of which had been electrified by the Wolfryn process before sowing. The land was very poor, and it was estimated that the untreated portion of the crop would scarcely return more than the three bushels of corn to the acre that had been sown upon it. The treated portion was far more vigorous, and bade fair to yield a profitable return to the farmer. The difference in the quantity of the yield was, however, of trifling importance beside another difference, which, though much less apparent at the time of inspection by the party than it had been a fortnight before, was still manifest. The untreated wheat was badly infested with the fungus of rust, and to this infestation some of the dwarfing and inferior development of the crop was due. The treated portion appeared to the naked eye to be entirely free from the fungus, and the contrast was so great that at the margin where the two crops adjoined, it was possible to pick out with certainty from the intermingled ears, those belonging to the other.

The instance is the more remarkable since, as a preventive against rust and other fungous diseases, both portions of seed had been sprayed with a solution of sulphate of copper. The one portion was then sown, and the other portion was electrified before being sown. In this case, therefore, the treatment with sulphate of copper was quite ineffective in preventing the attack of rust, while the same treatment combined with electrifying was, to all appearance, perfectly effective. Rust is communicated to the wheat plant from spores shed by the fungus growing on the barberry. These spores are distributed by the wind, and must have fallen with approximate equality of distribution on the treated and untreated crops. As with other infective diseases, both of plants and of animals, the infection finds a footing more readily, and establishes itself more easily and more thoroughly, upon the weaker organism. A stronger organism will be less seriously infected, and a still stronger organism may escape infection even though it is equally exposed, and does, in fact, receive as many germs of the disease as an organism that perishes under the attack. A thin coating of sulphate of copper upon the surface of the seed such as is produced by a mere spraying of the seed, is liable to be washed off by the rain, and even if it remains, is likely to protect the seed alone, and it is not the seed itself that is infected by the spores of the fungus. These attack the growing plants. By the electrical treatment the copper would be ionised, and ions of copper would be driven into the seed. It is possible that in the subsequent growth of the plant these ions may become distributed throughout its tissues, and may confer a certain immunity upon the plant, but it seems more likely that the relative immunity of the plant is due to its greater vigour and consequent power of withstanding disease. The infected plants would ripen their uredospores in June and July, and for many weeks the treated plants would be subject to the infection of these spores. It would be miraculous if, after weeks of this bombardment, the treated plants should show no sign of the disease, and, as a matter of fact, they, or some of them, were found to be infected; but the infection was so slight that one expert overlooked it altogether, and another needed the aid of the miscroscope to determine the existence of infection.

Be the explanation what it may, however, the fact remains that the electrically-treated portion of the crop was, to the naked eye, almost free from fungus, while the unelectrified portion was so badly infested that the red colour was manifest to the most superficial inspection.

It is difficult to exaggerate the consequence to the food supply of the world if this effect of electricity in preventing fungous diseases should be confirmed, and should be extended to other plants than wheat. Ergot of rye produces a fell disease, which would be put an end to. Fungous diseases of wheat, barley, and oats are the cause of many thousands of pounds of loss to farmers every year. Tomatoes and many other plants suffer badly from the ravages of mildew and other fungous growths, but the greatest value of all would be in the prevention of the various fungous diseases of the potato. It is unnecessary to say that if an effectual preventive of the *phytophythora infestans* had been known in 1845, the Great Irish Famine would never have taken place, the depopulation of Ireland would never have happened, the political relations between Great Britain and Ireland would have been very different from what they are now, and the political relations between Great Britain and America would have been very different in the last 60 years.

There is scarcely a crop cultivated by the hand of man that is not subject to fungous disease, and if an effectual preventive of fungous disease can be discovered—and it looks very much as if one was on the point of being discovered—the saving of human labour, and the increase of human wealth, would be in the strict sense of the term incalculable.

NOTES FROM ITALY.

By E. P. BENNETT.

The impressions of Italy that one forms while travelling through its cities and towns seem to be directly opposite to the impressions the Italians would make upon one in conversation; their chief emphasis is laid on their lack of wealth and the general poverty of the country. They quote the exchange, point to their dependence upon outside countries for coal, iron, and steel, and the amount of gold or its equivalent absorbed in their purchase, and generally declare the imminence of ruin in all directions. Perhaps you make a casual survey of the man who may be talking, and naturally look for some signs to confirm his statement. This man may be interviewing you at his own establishment, the outside of which looks imposing; the internal arrangements are very complete and of solid construction, his own office bordering upon the luxurious; the adjoining office for his right-hand man is of ample accommodation, and the general offices are well staffed and equipped with expensive typewriters, dictaphones, and adding machines. He, personally, is well dressed, sporting one or two pieces of splendid jewellery, and will in all probability invite you to a café, where the fare, though expensive, is in great demand. Here, again, is displayed not poverty, but considerable wealth, and abundance of time in which to enjoy it.

The city as you walk through it speaks of money in all directions; great buildings abound, of good architecture and costly ornament, which adds to the general appearance but is not necessary when money is scarce. For a moment in your walk the poverty will be forgotten, that is when you come to one of the many cathedrals; here with justified pride your friend will relate the spending of millions of lire, and that is money *spent*, not invested, for no returns are looked for or obtainable from the outlay, an outlay sufficient to capitalise an important industry. I merely quote the incident in relation to the story of poverty. When referring to industries, it is natural for me to inquire into the conditions of the one in which I am most directly interested—the electrical industry—and it is admitted that its position is not a forward one.

The generation is mostly by coal, and the selling price is, in places, as high as 3 lire per B. of T. unit, or just over 1s. 6d.; the kw.-hour is divided into 10 parts, and 30 c. is charged per part. There is a strong and growing desire

amongst the people to make early improvements, and to utilise the available water power to generate all the energy needed, and so make themselves independent of coal for lighting, heating, and cooking. In one direction this development seems to be going forward, as the mileage of electrical traction on the railways is considerable, and is always increasing.

Important schemes are on foot for longer tracts of line to be converted to electrical propulsion, and, from the same source, large tracts of country will receive a supply of energy for domestic purposes at a much lower rate per unit. The lamp-maker is not without his particular troubles in this country, for voltages vary over a wide scale; but the pressures most used appear to be 110, 125, and 160 volts, which is fortunate for safety's sake, the house-wiring and ordinary installations being done in a way difficult to realise in view of the precautions taken in our own country to prevent fire and personal risks. Insulated wires are run on porcelains outside the buildings, and a tapping is taken off for each floor by just baring the insulation and roughly binding round the wire for sub-circuits. This so-called joint is left without soldering or taping. The main wires are run into a feeder-board, constructed in wood and fixed outside the building, and the floor circuits are protected by a two-way board at the point of entrance—inside the building; from here the long runs are carried in thin-metal covered insulating tubes of German origin, and led through the walls in porcelain tubes to the rooms. The insulating tubes may be continued to point and switch, but most probably the run is made in white flexible, which, owing to repeated coats of paint received during periods of interior decoration, is quite hard, and apparently able to continue to carry all the current required for years to come.

One can, of course, find better installations, but I have given an outline of the general class of work. As might be surmised, the electrical contractor does not specialise in electrical work alone, but runs a combination business of plumber, gas, and electric lighting. His shop is an interesting one, well designed and fitted, with much space devoted to display, and each section treated separately. The combined exhibition does credit to his enterprise. It is of interest to note that the Italian Government shares in this enterprise, as every advertisement, display card, or notice of any description is taxed, a stamp being fixed and cancelled on each and every one exhibited; as a consequence, leaflets and placards are reduced to a minimum, and information concerning the various goods is given verbally.

The war has stimulated the local desire to manufacture for themselves the materials hitherto purchased exclusively from abroad; with the development of water-power generation it will not be long before many important items are being made in their own country, and there appears to be no reason why the manufacturing electrical industry should not soon be in a flourishing condition.

ELECTRIC VEHICLES.

By E. AUSTIN.

The position of the electric vehicle industry in this country at the present time is, on the whole, satisfactory, for, despite the adverse conditions that have prevailed during the last five years, there has been material progress in certain directions. Electric vehicles are becoming more and more conspicuous in London and elsewhere, and users are loud in praise of their performance. Certain influential individuals who in the past were either indifferent or antagonistic to electric battery traction, have been forced to adopt an entirely different attitude as the result of more or less recent developments, and are now expounding its virtues in a most authoritative manner. It has always been clear to all, save those utterly devoid of foresight, that the electric battery vehicle would ultimately establish itself, even in the days when accumulator manufacturers were quite incapable of producing cells suitable for road service. At the present time certain manufacturers who a few years back in no way interested themselves in electrical affairs, are building, or are preparing to build, electric vehicles of various kinds, whilst others are seeking works in which to commence operations. All this is very satisfactory. It reflects great credit upon the accumulator makers who have been largely instrumental in placing electric battery traction upon a sound footing, not to mention that small but energetic body of electrical engineers who for years past have been endeavouring to bring the electric vehicle into the limelight. Why this extremely arduous task should have been left to so few men, the writer does not pretend to understand. Surely nothing has ever been devised in the history of electrical engineering that affords better opportunities for improving central-station loads than the electric vehicle. Surely every central-station engineer must recognise now, at any rate, that there are tremendous possibilities in this new and important field of enterprise. Enough has surely appeared in the technical Press to show what has been done in this country, in America, and elsewhere, and to indicate the advantages of electric-battery traction in all its branches.

If there is a single central-station engineer who at the present time considers that electric vehicles are not worth bothering about, he must indeed be strangely constituted, and it is difficult to believe that such a person exists. Yet what do we find? Could anything be more unsatisfactory, more disappointing, more depressing, more disheartening than certain statements in the recently-issued report of the Electric Vehicle Committee? There are, we are told, many central-station engineers who have not even taken the trouble to procure a single copy of the Committee's official organ, and also many who have made no endeavour whatever to secure the purchase of an electric vehicle. It was, perhaps, to be expected. Few men trained as engineers can readily adapt themselves to commercialism in any shape or form. They nurse and cherish their plant with all the care and skill imaginable, but they fail to move with the times and to take advantage of the latest developments. It is a deplorable state of affairs. It makes some of us who have been endeavouring, in our humble way, to assist the movement with the aid of our pens, wish we had been engaged on some other form of work. It almost makes us wish that we were in some far-off land where there were no electricity supplies, no electric vehicles, and no apathetic electrical engineers. Of course, there has been a war. We are all aware of that. But the war is over, and the electric vehicle came into existence long before it began. How many central-station engineers took a really keen interest in the movement prior to 1914?—certainly not a great number. The bulk of the propaganda work, at any rate, has until recently been left to Mr. F. Ayton and a few others, who deserve all the praise and admiration that can be bestowed upon them. What the electrical industry owes to Mr. Ayton and his colleagues will probably be recognised in due course, but at present there does not appear to be any marked appreciation or enthusiasm on the part of some supply authorities.

It may be argued, and possibly rightly, that manufacturers are not yet in a position to turn out vehicles in large numbers or at a reasonable price; but even if this be true, there is not the slightest reason why propaganda work should not proceed. The advantages of electric vehicles must be clearly demonstrated to those who are likely to need them before there can be a large demand, and it is probably safe to assert that there are numerous possible buyers who do not at present even know that such things as electric vehicles exist. If it were not for the fact that the progress of the movement is dependent upon the electricity supply authorities the manufacturers would, of course, be in a position to build and sell their vehicles without hindrance in the same way as makers of petrol vehicles build and sell them. But, unfortunately, cans of electricity cannot be purchased by the roadside like cans of petrol, and, consequently, engineers who are neglecting to see what they can do in the way of providing adequate charging facilities are not only missing golden opportunities themselves, but are also hampering manufacturers. The central station engineer who imagines that because his plant happens to be an alternating one or because his working voltage is much

higher than the standardised battery voltages, electric vehicles are not worth considering is unworthy of the position he holds. Much has been made of the difficulties of charging, yet in reality the whole thing is simple. What ought to be encouraged as far as possible is charging on owners' premises in stables and other places where vehicles are usually kept. A small motor-generator or rectifier installed in such places solves the problem completely. Charging garages may, of course, be established as well, and vehicles may also be charged at central stations, but there is no doubt whatever that it will be found in many cases that vehicle owners will be quite prepared and willing to install charging equipments of their own.

The writer is not unfamiliar with the various organisations now working in the interests of the electric vehicle movement. Still it is clear that unless some of the central station engineers are going to display more enthusiasm than they have in the past the industry cannot possibly progress at its proper rate. There is no reason, so far as the writer can see, why practically every station in this country should not derive benefit from this new and important development. The use of electric trucks alone is bound sooner or later to have an influence upon central station loads, especially in large manufacturing districts. The value of these trucks to manufacturers, shippers, merchants, and others, is at present very imperfectly understood, and it behoves supply authorities to familiarise themselves with electric truck applications, and to make them known to people who are likely to be interested.

FOREIGN TRADE.—II.

Electricity in Spain and Portugal.

[By One Who has Travelled Much.]

The end of the blissful state of affairs caused by the restriction of imports appears to be approaching, and then, no doubt, manufacturers in England will seriously turn their attention to getting business in foreign countries, disabusing themselves of the idea that what is accepted in the British Empire will necessarily be accepted in other parts of the world irrespective of its price.

The mountainous nature of both Spain and Portugal places at the disposal of their inhabitants an enormous and constant source of electric power, with the result that every town of importance and many of practically no importance are provided with electricity. Unfortunately this very excellent market was almost entirely neglected by English firms before the war, and those firms who did make some effort to do business refused, as a general rule, to grant the long credits customary in the country, and almost without exception failed to supply the class of goods which was asked for and was being supplied without question by the German firms who years ago realised the importance of the market and established themselves under local laws.

The German firms in question do not appear to have suffered at all from the effects of the blockade, as they were sufficiently foreseeing to either finance factories themselves or to assist others to do so, as a result of which all their various depots throughout Spain were able to carry on since 1914 as if nothing had happened. Since the conclusion of the armistice last November, numbers of firms in this country have received more or less verbose effusions in Spanish or French pointing out the supposed possibilities of the Spanish market.

Naturally most of our firms on receiving a letter of this kind either consign it to the depths of the W.P.B., or else they send a short acknowledgment written in English requesting our Spanish friend to in future be kind enough not to write in his own language, stating also that they trust in Providence, but others pay cash against shipping documents.

This is not a particularly enterprising way of opening up new business, but when the lamp manufacturer in this country takes the trouble to acquaint himself with the fact that the Customs duty on electric lamps going into Spain works out a 4s. per pound, and when also he gets wise to the fact that electric lamps are made in enormous numbers in Spain, he very naturally decides to sell his lamps in England, where he can get more for them and avoid trouble in collecting accounts.

Unless our lamp manufacturers are in a position to supply a low-voltage gas-filled lamp consuming about 25 watts to compete with a well-known Dutch make, they are wasting their time and money in attempting to get orders in Spain, although in Portugal Customs duties are not nearly so high, and they may be able to find some market for any surplus.

Voltages are as a rule between 100 and 150, and Edison screw caps are used almost universally.

For the manufacturer of electrical accessories the position is almost hopeless. Types used in England will find no market in Spain, as they are too dear, too heavy, and the porcelains are the wrong colour, also tumbler switches are hardly used at all. House wiring in Spain at present is carried out in at least 90 per cent. of the installations with low grade flex on insulators, and costs about 10s. per point as against 30s. in this country, where rules are far more stringent.

The Customs duty on lampholders works out at about 1s. per pound, and it is absolutely impossible to sell the heavy English stuff to compete with what is made in Spain at about one third of the price, especially when the native article is quite satisfactory, and compares favourably with the lighter classes of accessories made in Japan and the U.S.A.

Unless the British maker is prepared to offer material similar in type to and comparing favourably in price with the local article he is wasting his time trying to do any business either in Spain or Portugal.

The maker of V.I.R. cables and flex are much in the same position. Insulation in these southern countries is not considered to be of such importance as it is in England, and it will be found that the V.I.R. wires and cables made in Spain will hold their own in price against any imported article.

The meter maker is in quite a favourable position as regards the Spanish market. Customs duties are high, and amount to about 1s. 6d. per pound weight, but as no meters are made in either Spain or Portugal, all makers are in the same position, and the one able to cut down the weight of his goods will get the order provided his meter has received the approval of the authorities. Measuring instruments are subject to a fairly steep Customs duty. A certain number of ammeters and voltmeters are made in Spain, and as these are fitted in cases made of brass spinnings the British maker will have rather uphill work in selling instruments in iron cases which are handicapped with a duty of 15s. each.

The manufacturers of generators, motors, transformers and heavy switchgear have nothing to fear from local competition or Customs dues.

There is an excellent opportunity for motor control gear, but it must be borne in mind that very very little D.C. is used except in Madrid and Barcelona.

In concluding these few remarks it may be stated that the financial situation in Spain is very favourable, and there are numbers of big projects about to be started on. It is quite as easy to do business in Spain as it is at home, but it must be remembered that the Spaniard is master in his own house, and that if business is to be done with him, he must be offered what he wants and not what we think he ought to have.

It is not remarkable that he should prefer to be quoted c.i.f. prices and ask to be addressed in his own language. Finally, there is quite an excellent outlet in Spain for certain classes of electrical goods if manufacturers are only prepared to look for business and adapt themselves a little to the ways of the country.

ELECTRICAL PHENOMENA OCCURRING AT HIGH LEVELS IN THE ATMOSPHERE.

By S. CHAPMAN, M.A., D.Sc.

(*Abstract of paper read before the* Institution of Electrical Engineers.)

The electrical phenomena which will be considered in this paper occur at "high" levels, above 10 or 15 km. from the ground. They make themselves apparent in two principal ways; by luminosity and magnetic effects. The changes of magnetic force at the earth's surface originate mainly in the upper atmosphere, directly or indirectly. The direct part is due to electric currents in the atmosphere, the indirect to secondary currents induced by the former in the conducting earth; the ratio between the two corresponding portions of the magnetic effect at the surface is 2 or 3 to 1. The earth currents flow at greater or lesser depths according to the rapidity with which the external currents vary; those associated with the regular daily magnetic variations flow chiefly at 200 or more kilometres below the surface. At times of magnetic disturbance the changes are much more rapid, and the earth currents do not penetrate so far down.

The moon, as well as the sun, affects the earth's magnetic field, and there are lunar diurnal magnetic variations, depending on the moon's hour angle (or local lunar time), which are of as great interest as the ordinary solar diurnal variations, though of inferior magnitude.

From the sun, the earth is seen to be moving along in its orbit from right to left, and to be turning about its axis so that the front, sunlit, hemisphere is moving from left to right. Since the sun itself is turning about its own axis in the same direction as the earth, any emission from its surface which happen to be directed towards the earth would sweep the latter from right to left.

The magnetic variations are not caused by direct magnetic action on the part of the sun or moon; nor do they represent the varying magnetic field of streams of electric charges of one kind, moving separately from charges of the opposite kind, whether within or outside the atmosphere. They are, in fact, variations in the magnetic field of electric currents of the ordinary type flowing in more or less horizontal layers in the upper atmosphere; that is, currents in which the magnetic field is unaccompanied by any appreciable electrostatic field. They are produced, moreover, in essentially the same way as are the currents generated by electromagnetic induction. The earth's permanent magnetic field (the origin of which is still unknown) constitutes the magnetic field of the terrestrial dynamo. The atmosphere itself in motion owing to various causes, is the armature, while certain layers which are specially ionized (mainly by solar action) are the conductors in which the flow of electric current takes place.

The atmospheric motions concerned are of two kinds, one set being associated with the quiet-day magnetic variations, while the other set is connected with magnetic disturbance. The latter motions originate in and are confined to a region high up in the stratosphere: the former extend throughout the troposphere and a large part of the stratosphere, but are electromagnetically effective only at a considerable height above the base of the stratosphere. Below this level the air is not sufficiently conducting to allow any appreciable flow of

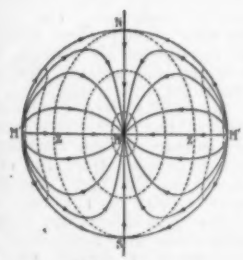

Fig. 1.

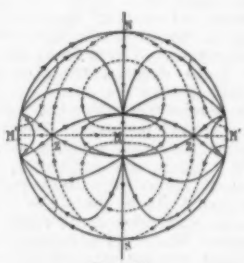

Fig. 2.

current, so that the irregular convective motions in the troposphere have no part in producing the magnetic variations.

The set of atmosphere movements which gives rise to the quiet-day diurnal magnetic variations consists of two great world-wide circulations of tidal type. One is a true tidal motion, due to the moon. The other, of similar character but of different phase and fifteen-fold the amplitude, is of solar origin; it is mainly produced by thermal—not tidal—action. The difference in phase indicates a difference of orientation of the two systems of circulation relative to their governing bodies the sun and moon. Moreover, the orbital motion of the moon causes the lunar tidal system of circulation to shift relative to the solar system, completing one revolution, in the same sense as the earth's diurnal rotation, in a lunar month.

In each case the movement of the air is mainly horizontal. Fig. 1 shows lines of equal pressure (dotted) and of instantaneous direction in a tidal system of circulation in the earth's atmosphere. Maximum pressure occurs at M and minimum at M'. The meridians NZS are lines of zero pressure. The current-lines in the case of such tidal motions are indicated in fig. 2, where for simplicity a particular phase, different from that of either the solar or lunar circulations, has been adopted. The maximum velocity occurs at the equator, and in the solar case is approximately 1 km. per hour. The velocity is nearly the same at all levels up to a considerable height; the solar diurnal circulation, however, seems not to extend so far up as the lunar circulation; the latter is present in the auroral layer, at a height of 100 km., while the solar diurnal movement does not seem to exist there.

These two movements are of semi-diurnal type; that is, the motion in either case is the same over the two halves of the earth separated by any meridian plane. The motion being horizontal, the induction takes place across the vertical component of the earth's magnetic force. This component is downwards in the northern, and upwards in the southern hemisphere, but is otherwise nearly symmetrical with respect to the equator. The induced electromotive force is perpendicular to the direction of horizontal motion, to the left in the northern, and to the right in the southern hemisphere.

Fig. 2 shows electric current-lines (dotted) and lines of horizontal magnetic force at the earth's surface, resulting by electromagnetic induction from the circulation shown in fig. 1. The systems of electromotive force, like those of atmospheric motion, are semidiurnal (fig. 2); but the systems of horizontal electric currents impelled by those forces, in the layer which is sufficiently conducting to give scope to them, are not of this type. Their intensity is much greater over the sunlit than over the dark hemisphere. This is shown by the considerably enhanced activity of the solar and lunar diurnal magnetic variations resulting from these currents, during the hours of solar daylight, and during the season of the year (summer) when, at a given station, the rays of the sun are most directly received. The lunar diurnal magnetic variations exhibit the effect particularly clearly; since the lunar tidal system of circulation progressively advances relative to the sunlit hemisphere (*vide supra*), the lunar hours during which the electromagnetic effect is magnified regress throughout the lunar month; the character of the lunar diurnal magnetic variations consequently changes regularly in the course of a lunation, the activity being greatest during the hours of solar daylight at each epoch.

Besides this daily and seasonal variation in the intensity of the quiet-day magnetic changes, the latter vary considerably in intensity (while preserving their type almost unaltered) throughout the cycle of solar activity. The one variation indicates a dependence on the position of a station relative to the sun, the other on some intrinsic solar factor affecting the earth as a whole. Both effects are explained by supposing the electric *conductivity* of the layer of air in which the currents flow to vary in the manner described; and that this is because the conductivity is produced by some solar ionising agent. This agent is ultra-violet radiation, which must be emitted more strongly at sunspot maximum than at sunspot minimum. It is shielded from the dark hemisphere, but over the sunlit hemisphere it penetrates to a considerable depth in the earth's atmosphere, much below the under limit of the auroral layer (about 100 kilometres above the ground). It seems likely that it is the lower surface of the layer thus ionised by solar radiation which is responsible for bending "wireless" waves round the earth, and so increasing the distance over which messages can be transmitted in this way. Prof. G. N. Watson has recently given conclusive proof that, unless prevented by the presence of such a conducting layer, the electric waves would in large part travel outwards into space, instead of, as they are observed to do, round the globe.

Magnetic disturbances and aurorae are produced by the injection into the earth's atmosphere of electric corpuscles projected in confined streams from disturbed regions on the sun. These streams may be emitted in any direction, so far as we know at present; their existence is made known to terrestrial observers only when a stream is projected so that, in the course of the solar rotation, it sweeps over the earth. The streams are often of considerable angular diameter, *e.g.*, 10 degrees or more. As the angular diameter of the earth, viewed from the sun, is only 18.6 seconds of arc, it becomes completely enveloped in the streams; and often remains so for hours or even days, notwithstanding that the relative speed of the streams at the distance of the earth enables them to sweep right across the earth in 35 seconds. The latter fact explains why magnetic storms, the particularly intense and world-wide disturbances which occur when the earth is enveloped in a dense solar stream, are observed to commence at almost the same instant all over the earth. Again, since disturbed regions on the sun often continue to emit streams of electric corpuscles in the same relative direction for a period of more than one solar rotation, a given stream may traverse the earth more than once. This

accounts for the observed tendency for magnetic conditions to recur after an interval equal to the time taken by a stream to reach the earth again, after a complete rotation with the sun. This, which is shown by quiet, no less than by disturbed conditions (corresponding respectively to the absence and presence of streams in the earth's neighbourhood) is only a tendency and not a definite periodicity; for the sequence of streams existing at any given time is continually being interrupted by the cessation, or alteration of direction, of old streams, and the initiation of new ones.

The streams seem to consist entirely or predominantly of corpuscles having the same sign of electric charge. They are ejected from the sun with a speed comparable with that of light, and travel outwards approximately in straight lines. When they approach the earth their rectilinear motion becomes modified owing to their entry into the earth's magnetic field. It appears that, though in an intense stream the particles seem to impinge upon the atmosphere from all sides, there is a strong tendency for them to be drawn in towards the earth's magnetic poles; yet not so as to fall most numerously at the magnetic poles themselves, but rather around two zones, one centred at each such pole. The radius of the zones can be calculated approximately, but depends upon the nature and speed of the particles. The zones are naturally identified with the zones of maximum auroral frequency; these are centred as described, and have a radius of about 20 degrees. This is much greater than the radius calculated on the assumption that the solar corpuscles are β-particles (*i.e.*, negative electrons, having a mass much less than that of a hydrogen atom, though travelling with great speed). On the other hand, the observed agrees pretty closely with the calculated radius, if the particles are supposed to be α-particles, positively charged, but otherwise identical with ordinary atoms of helium moving with great velocity.

Three principal consequences follow from the injection of the solar corpuscles into the earth's atmosphere. First, the particles break up many of the molecules which they encounter before being brought to relative rest in the atmosphere. This means that the layer in which the retardation takes place is ionised; during times of magnetic disturbance, therefore, there are two conducting layers instead of only one. Second, where the ionisation is particularly intense it is accompanied by luminosity; this accounts for the polar distribution of auroræ, and their association with magnetic disturbance. The production of the latter depends on the third effect mentioned, viz., the electrification of the air. This is accompanied by electrostatic forces of sufficient intensity to impart an important degree of motion to the extremely rarefied air. This is the second of the two types of motion referred to above.

The general nature of the movement can be readily inferred. The mutual repulsion of the entangled charge spread over the world-wide spherical layer produces an upward, outward movement, as in a charged soap-bubble. Thus the air travels vertically upwards—except during the first few minutes of a magnetic storm. For at first the downward momentum of the injected particles depresses the air, before the electricity has accumulated sufficiently to reverse the motion.

In the process of electromagnetic induction the vertical movement acts by cutting across the horizontal component of the earth's magnetic force. Since the latter is directed from north to south, the upward motion induces an electromotive force from east to west, while the initial downward velocity induces one in the opposite sense. An electric current flowing from west to east, as in the latter case, will increase the horizontal magnetic force at the earth's surface; this is what is usually observed in middle and lower latitudes during the first few minutes of a magnetic storm. Afterwards the reversal of motion of the air, and of the resulting electromotive force, causes a diminution in the horizontal magnetic force; this is one of the most characteristic features of magnetic storms.

The electromagnetic effects of a storm are not of the simple type which might be expected; complication arises mainly from the unequal distribution of the corpuscular injection. This inequality is due to the deflection of the particles by the earth's magnetic field, and to the circumstances of emission from the sun. Visual observation of the auroræ strongly suggests that the injection is both "patchy" and intermittent.

This causes the ionisation of the air to vary considerably from place to place, and the inequalities of conductivity thus set up are likely to endure for some hours. Consequently, even if the electromotive force were quite uniform in direction and intensity, the current-flow would be far from uniform. The great *intensity* of disturbance in polar regions is due to the high average value of corpuscular injection and ionisation around the poles. There is evidence that the conductivity in the "maximum auroral zone" is particularly intense.

Besides these inequalities solar corpuscles fall more intensely over the p.m. than over the a.m. hemisphere. Thus the two solar ionising agents have different "most favoured hemispheres"—the sunlit one being that most affected by the ultra-violet wave radiation.

This longitudinal inequality of conductivity in the auroral layer shows itself in the production of a greater diminution of the horizontal magnetic force, in middle and equatorial latitudes, over the p.m. than over the a.m. half of the earth. This appears clearly from the disturbance diurnal variation of horizontal magnetic force in the latitudes mentioned (fig. 3); the disturbance diurnal variation in the other magnetic "elements" and in other latitudes likewise indicates the existence of excessive precipitation of corpuscles over the p.m. hemisphere and round the "auroral maximum" zone. Fig. 3 shows current-lines (dotted) and lines of horizontal magnetic force at the earth's surface, corresponding to the disturbance portion of the solar diurnal magnetic variation, as viewed from the sun.

While the non-uniform injection of charge results in the existence of inequalities of electrical conductivity over the spherical layer affected, the charge itself is continuously redistributed so as to keep the surface density of electrification practically uniform. In the case before us the conductivity seems quite large enough to permit the redistribution to take place with a rapidity altogether exceeding that of the escape of the charge right away from the atmosphere, which does ultimately result. The redistribution seems to be of an oscillatory character, accompanied by the propagation into space of Hertzian waves of wave-length approximately equal to the diameter of the earth. The period of these waves is about one-twentieth of a second.

The precipitation of electric charge into the atmosphere does not produce an "electric storm" at the earth's surface, as well as a magnetic storm. During a world-wide magnetic storm, indeed, in which the extension of the corpuscularly ionised layer all round the earth permits a uniform redistribution of the charge, no change in the electrostatic field

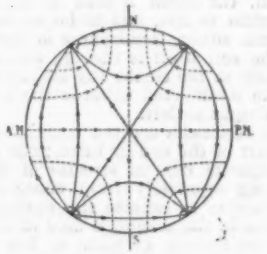

Fig. 3.

at the earth's surface would be expected. But even in the case of a minor disturbance, due to a stream of corpuscles which falls upon, and renders conducting, only a limited portion of the upper atmosphere, no electrostatic change at the earth's surface is observable. This seems to be owing to the electric shielding effected by the other ionised layer, which extends all round the earth. This layer is lower than the other, so that local charges in the auroral layer do not electrically affect the interior of the "diurnal variations" layer.

There is a tendency for the brightest part of auroral bands and rays to occur at their lower edge, though in the case of rays it is occasionally found some distance above this level. This confirms Vegard's hypothesis that solar particles are α-particles. Such particles, of molecular mass, are found to penetrate to a definite distance when projected into a gas; they travel in practically straight lines for this distance and then come to a relatively dead stop when their velocity is reduced to that of the surrounding molecules. The ionisation is greatest shortly before they reach their limit of penetration. These features are manifested by auroræ, and are quite distinct from those which characterise the projection of negative electrons, β-particles, into a gas.

It seems probable that the ρ-particles are products of radio-active processes occurring on the sun. This would explain the high speed and homogeneity of the corpuscular rays. Again, the suggestion derives support from the existence of ultra-violet light radiation. In the past, discussion concerned itself with the relative merits of the two—corpuscles and ultra-violet light—regarded as *alternative* ionising agents. The two attendant difficulties are avoided if we suppose the ultra-violet light to consist of γ-rays, *i.e.*, the extremely penetrating wave-radiation which in certain radio-active processes accompanies the emission of α-particles and β-particles. These γ-rays are immensely more penetrating than either β or α-particles, so that as the latter prove able to escape from the sun's atmosphere, it is natural that the γ-rays should likewise do so, and will maintain their superior penetrating power, and so ionize a layer in the terrestrial atmosphere lower than the auroral layer. The rays do not travel to a definite distance before absorption, as do the α-particles; their intensity diminishes exponentially with the mass of the gas traversed.

The γ-radiation seems to vary continuously and gradually, while the streams of corpuscles are discontinuous and intermittent. The author attributes this to the fact that the radiation, whether produced locally or, as seems more likely, all over the sun's surface, will spread out in all directions—what we receive at the earth coming from the whole of the emitting area. In the case of the corpuscles, probably they either cannot escape at all from the sun's general magnetic field, or can do so only in diffuse masses, except where the intense magnetic fields which exist over the sunspots

provide a "guide" along which they can stream outwards. The time taken by the solar corpuscles to reach the earth, if they are α-particles, can be assigned as from about two to three hours.

It may be that the β-particles, emitted during the radio-active processes mentioned, escape from the sun diffusely, or, if in streams with the α-particles, that they become dispersed, owing to their much greater deviability, before they reach the earth. Certainly they must escape from the sun in some way, and there seems to be no evidence that two kinds of corpuscles reach the earth.

If the above suggestion is confirmed, that radio-active transformations on the sun are responsible for the emissions which affect the earth's atmosphere, such processes must play a much greater part in the economy of the sun than has generally been supposed; and they must be intimately connected with the cycle of variation of solar activity, for the ultra-violet wave radiation (here identified with γ-rays) is twice as intense at some sunspot maxima as at sunspot minima.

The author hopes that it may not be without interest to electrical engineers to consider briefly such examples of how the principles underlying the more familiar applications of electricity are ilustrated, in various ways and on a large scale, in Nature.

A SEAPLANE WIRELESS TRANSMITTING SET.

Although the type of aircraft wireless transmitter here described was designed for HS type seaplanes, it was first installed on the NC type of U.S.A. flying boat in the recent trans-Atlantic flight. These sets were designed to give a normal operating range of 350 to 400 miles under ordinary or about 250 miles under adverse transmitting conditions. During this flight the Navy Department states that these transmitting sets were heard over a distance of 1,200 miles.

The complete set consists of all the accessories necessary to install, repair, and replace broken parts. The actual set as installed in the plane is described in the *T. and T. Age*, from which the following particulars are taken.

The transmitter itself (fig. 1) consists of a 550-watt, self-excited inductor-type alternator, and an aluminium sheet or casing, of the same diameter as the generator and attached to the rear thereof, in which are contained the power transformer and the rotary spark gap. To the end of this aluminium shell is attached a streamlined hood, composed of fabric impregnated with bakelite. This serves as an enclosure for the condenser and the oscillation transformer which are bolted to the aluminium shell extending back from the generator. The hood is attached to the aluminium shell, and is readily removable for inspection and adjustment. The aluminium casing is also provided with a watertight hand hole, by which access may be had to the rotary gap.

The generator itself is a special inductor-type alternator, designed for a speed of 5,000 R.P.M. and develops from 135 to 150 volts on open circuit at 1,000 cycles. The full load voltage is approximately 100 volts. The stator consists of four D.C. poles, into each of which are cut four slots for the A.C. winding. The rotor is made with 12 teeth and acts as the inductor. The D.C. winding for exciting the field is wound in the slots between the teeth and delivers current to the field through an externally mounted field switch. The switch is arranged so that the alternator field circuit is closed only when transmitting, and in closing the circuit a battery is momentarily connected in to ensure its building up.

The gap equipment comprises two rotors, one having twelve and the other eight teeth, mounted directly on the generator shaft by an insulating moulded hub. This gives the set two different spark tones, 1,000 and 666 sparks per second, which greatly increases the selectivity of the transmitter. The fixed element consists of two tungsten electrodes mounted on a holder which can be rotated through 180 deg.; the other electrode is brought into use with the twelve-tooth rotor, while the one located opposite the eight-tooth rotor is inoperative. By means of an eccentric bushing in the bracket by which the electrode holder is mounted on the generator rear bearing housing, the distance between the tips of the rotor teeth and the fixed electrode can be adjusted. The angular adjustment is obtained by loosening the clamp that holds the electrode bracket.

The power transformer is of the closed core type, the ratio of transformation being approximately 1 to 34. The condenser is of the mica dielectric type, having a capacity of 0.010 mf. The oscillation transformer is of the conductively coupled type, and consists of seven turns of No. 10 B. & S. bare copper wire wound in grooves in a bakelite cylinder. Three taps are brought out, with suitable terminals for the primary connection, by which the primary can be adjusted to wave lengths of 335, 375, and 425 metres. The terminals for the primary connections are mounted on the base of the oscillation transformer. The coupling taps are brought out to a switch located on the rear end of the oscillation transformer, and permit adjustment to six degrees of coupling.

The antenna used is of the trailing type, consisting of a 230-ft. length of silicon bronze stranded antenna wire to the end of which is attached a stream-lined lead weight. The antenna is brought into the cockpit through insulators having a metallic bushing with flared ends to a reel upon which the antenna is wound when the plane is about to descend. Connection to the antenna is made by a terminal connected to the bushing in the insulator.

The antenna is paid out to its full length, and the open circuit tuned by means of a variometer which is assembled to include a hot wire ammeter for indicating resonance. The variometer consists of fifty turns of No. 14 B. & S. bare solid copper wire wound on a thin, hollow cylinder. The inductance is varied by means of a trolley, hand operated through a rack and pinion, which moves parallel to the axis of the coil, and makes contact with the bare turns of the coil through a recess cut in the cylinder. The trolley can, therefore, be made to cut in, or out, one turn of wire at a time as it is moved along. The dead end of the coil is connected to the trolley contact and is thereby short-circuited. A copper ring

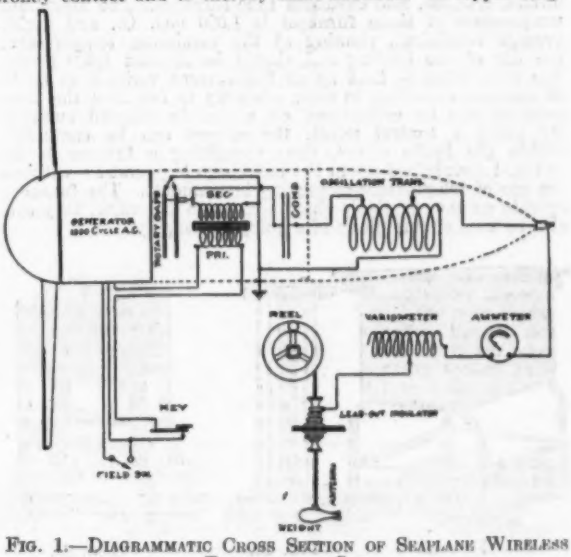

Fig. 1.—Diagrammatic Cross Section of Seaplane Wireless Transmitting Set.

moving with the trolley inside the coil serves to prevent sparking at the trolley contacts by shielding the magnetic lines of force from the turn short-circuited by the trolley.

On the NC type of trans-Atlantic seaplane a special mounting was arranged on a rear strut in the centre of the boat, so that when the boat was not flying, the transmitter could be moved up on the strut into the wash of the propeller of the centre engine. This engine could then be run at a speed not sufficient to cause the boat to move, but still sufficient to operate the wireless set. When operating under these conditions a T antenna strung across the top of the boat between the skid-fin of the plane is used, and a lead-in dropped down from the centre. The earth is made at the keel of the boat.

The leads from the transmitter are brought through the wall of the boat to the cockpit. In order to make it possible to operate the set from various points of the boat several keys are installed, which are of the flame-proof type, and are equipped with winker lamps connected to a transformer across the key contacts, which indicate whether or not the line is in use. When no keys are being operated the lights burn continuously until one operator presses his key. Then all lights go out corresponding to the operation of the key.

The set here described was designed and built by the International Radio Telegraph Co., of New York.

Engineering Congress at Java.—Arrangements have been made for holding a general engineering congress at Batavia, Java, in May, 1920. *Eastern Engineering* says it is evident that the proceedings will have very great importance to British engineers, having regard to the information it will supply as to forthcoming projects in the Far East. The congress will deal with harbours and means of communication (including railways, tramways, telegraphy and telephony), irrigation, drainage, waterworks, &c.; roads and bridges, town planning, architecture, &c.; the production of energy, electricity, and industries (including ironworks, factories, and agricultural industries), mining and geology. It will deal with other subjects such as technical education, the artisan question, building materials, and aerial navigation. Invitations have been issued to engineers in countries bordering on the Pacific and Indian Oceans. The main object is to influence the technical development of Eastern Asia. The proceedings will be conducted in Dutch and English, and it is expected that the congress at Batavia will do much toward solving technical problems, as well as towards assisting in the development of the pan-Pacific movement by the opening up of new routes, and the consequent extension of trade and the dissemination of information. The address of the secretary of the congress is Kebon Sirih, 56, Batavia, Java, Netherlands India.

THE BRITISH SCIENTIFIC PRODUCTS EXHIBITION.

(*Continued from page 203.*)

Messrs. A. Gallenkamp & Co., Ltd., 19-21, Sun Street, Finsbury, E.C. 2, exhibited a Berthelot-Mahler bomb calorimeter of British manufacture with a modified bomb by Dr. K. Krocker, for the determination of the calorific value of solid and liquid fuels. Electrolytic-copper protected glassware and a stand for electrolytic analysis, arranged to take any type of electrodes, and to rotate one of them, as well as electric furnaces of various types were also shown. Gallenkamp furnaces are designed for laboratory and small industrial heating, the standard types being: Vertical and horizontal tube furnaces, 2- and 4-tube furnaces for carbon determinations, muffle, crucible, and explosion tube furnaces. The maximum temperature of these furnaces is 1,000 deg. C., and under average conditions, running at the maximum temperature, the life of the heating coil should be at least 1,000 hours. The time taken to heat up on full current varies from 30 to 60 minutes according to size; when up to full heat the temperature can be maintained on a greatly reduced current. By using a control panel, the current can be controlled within the limits stated, thus permitting a furnace to be run and maintained up to the maximum temperature without the use of temperature-measuring instruments. The furnaces operate on D.C. or single-phase A.C. up to 250 volts; they can also be used on one phase of a polyphase supply.

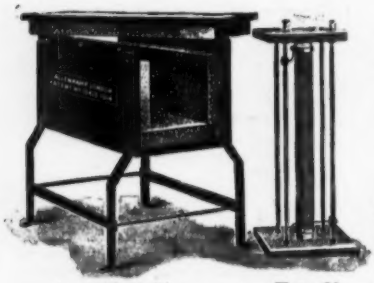

Fig. 19. Fig. 20. Furnace Construction.

Fig. 21. Crucible Furnace.

Figs. 19 and 20 show the construction of the furnace; the heating unit, wound with the heating coil, is fixed in the frame, and connection is made from the coil to the two bottom tie rods (fig. 20). The frame slides into the casing (fig. 19), which is lined with lagging bricks, the space between the bricks being packed with insulating material. From these illustrations it will be seen that to fit renewal units is quite a simple operation.

The heating chamber is made of pure fused silica, one of the most refractory of materials, melting between 1,700 and 1,800 deg. C. The coefficient of expansion of silica is extremely small, and it is therefore possible to subject the heating chamber to rapid changes of temperature without danger of breakage.

Alundum can be used for the heating chamber if desired. The thermal conductivity of this material is very high, and it has a melting point of 2,050 deg. C. (3,722 deg. F.). For temperatures up to 1,000 deg. C., a winding of special high resistance alloy is used. This alloy has been specially developed for use in electrical resistance furnaces, having a very small temperature coefficient (+0.0009 per 1 deg. F.), and being strongly resistant to oxidation. The winding is protected with a special cement, which keeps the coil stationary. The space between the lagging and the winding is packed with insulating material, which arrangement effectually prevents oxidation and corrosion of the winding. The lagging is in the form of slabs, and is made of a material consisting chiefly of silica. The frame (fig. 20) consists of end walls of refractory material held apart by 4 steel tie-rods, two of which have terminals attached at one end, and serve as conductors to the winding. The "live ends" of these two rods are covered by insulated nuts. The end walls are recessed to take the ends of the heating chamber, and hold them firmly, preventing side play. The casing (fig. 19) is made of sheet iron, and is provided with a separate brass terminal for earthing purposes.

Hardening of carbon steel can be satisfactorily carried out in vertical tube furnaces, which can stand directly over the quenching tank, so that at the correct temperature the work can be released and dropped directly into the tank. The power consumption to maintain 1,000 deg. C. varies from 400 to 800 watts, with tube lengths of from 12 to 20 in., with an internal diameter of from 1 to 2 in.

Two- and 4-tube furnaces are now largely used for the determination of carbon in steel; using a four-tube furnace, 50 estimations have been accomplished in 8 hours. In these furnaces the length of tube varies from 12 to 16 in., and the internal diameter from 1 to 1.75 in., the approximate power consumption being from 600 to 1,200 watts. Muffle furnaces are suitable for ash determination, ignition of precipitates, incinerations, fusions, heat treatment, hardening and annealing, enamelling, &c. They are fitted with an adjustable sliding door and a chimney with baffle plate to control the draught through the muffle. They are lagged to prevent cold ends of the muffle, and a hole in the back wall is provided for the insertion of a thermo-couple. The working space inside the muffle varies in length from 8 to 14 in., in width from 2.5 to 7 in., and in height from 2.5 to 4½ in. The maximum working temperature is from 950 to 1,000 deg. C., and the power consumption from 750 to 2,300 watts. Crucible furnaces, as illustrated in fig. 21, are useful in analytical work and for freezing-point determinations, in the standardising of thermo-couples, &c. They can be made with closed bottom silica crucibles, and can be used for fusing low melting point salts, for salt bath hardening, quenching, and tempering. The size of the heating chamber varies in height from 3.5 to 5.5 in., and in diameter from 2 to 3 in., the consumption being from 500 to 600 watts. Explosion tube furnaces, for heating substances in glass tubes, are made with 2 or 4 tubes, 18 in. long and 1 3/16 in. bore. Steel tubes with caps are supplied to slide into these tubes, and the lid is furnished with a tubulure for a thermometer. The power consumption at 400 deg. C. is from 500 to 700 watts.

In the control of the heat treatment of carbon tool steels a gap has been experienced between the highly accurate but

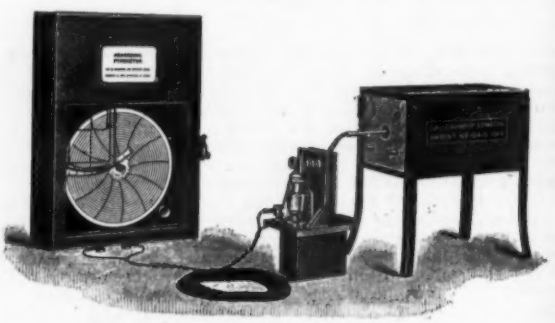

Fig. 22.—Recalescence Pyrometer.

delicate and complicated laboratory apparatus used to determine the critical point of steel and the relatively robust industrial pyrometers used in the factory. The instrument produced for this special work is a recording pyrometer outfit, in which patent alloy wires are employed, naturally in gauges of smaller diameter than those used in the industrial furnace instruments, but still retaining the advantage of high electromotive force, indifference to contamination by metal vapours when in direct contact with heated steel and low cost of replacement as compared with the platinum alloy couples previously used for this work.

The robustness of the recorder is further enhanced by the mounting of the moving coil of the instrument upon patent spring-mounted jewels, thus shielding the pivot points from damage due to vibration in handling. The thermo-couple is attached to two double terminals on the cold junction stand (shown in fig. 22), and the circuit is thence made by a compensating extension into an oil flask, surrounding the actual cold junction. This flask is shielded from direct radiation of the sample when heated, by a double shield with an air space between, and is also provided with a mercury thermometer by means of which the actual cold junction temperature can be observed. The circuit is then made to a second pair of double terminals on the base of the stand, and thence by flexible cable to the recorder. With the circuit open, that is, not connected between the thermo-couple and the recorder, the pointer of the recorder is set to the observed cold junction temperature, by this means no cold junction correction is necessary to the observed reading of the recalescent point. The sample of steel under examination is heated in the patent electric furnace; the furnace shown in the illustration is 12 in. long by 1.25 in. bore. The sample about 0.75 in. diameter, 1 in. long, and with ¼ in. hole drilled axially 0.5 in. deep, is placed at the centre of the furnace with the hot junction of the thermo-couple inserted in the axial hole. The furnace is then blocked at each end and the current turned on. The heating being uniform the heating curve as recorded by the instrument will also be uniform unless there is any micro-structural change in the sample which absorbs or emits heat. In the case of high-carbon steel the decalescent point has such a micro-structural change and the temperature at which this decalescence takes place is clearly shown on the record by a halt or flattening of the curve. When the temperature in the furnace reaches 850 deg. C., the current is cut off; the sample will then cool uniformly until the recalescent point is reached, where the halt is very clearly shown.

Marconi's Wireless Telegraph Co., Ltd., Marconi House, Strand, London, W.C.2. These exhibits and demonstrations referred to wireless telegraphic and telephonic communication with ships and aircraft, and to direction finding. Only the fixed-station method is supposed to have been used by the

Germans during the war, whereas the British made use of both the fixed and movable station methods. The advantage of the former method is that it is not limited as to aerials and power, and that it can command expert operation; the method, however, is slow, and necessitates the fixed stations being under constant central control, excluding all disturbance by commercial traffic. The process is simplified, but the instruments on board will be less sensitive and less powerful when the craft itself is fitted with direction-finding gear. A modified fixed-station method has been adopted both in this country and in Canada for civil marine navigational purposes, a wave length of 450 m. being used in this country. The direction-finding set exhibited was of standard pattern, except the aerials, which, owing to the exigencies of space, were very much smaller than usual. The experimental arrangement at the exhibition was as follows: The company's stand was in the form of a square hut; the two fixed coils crossed one another diagonally on the roof, the wires of each passing down one pair of opposite hut corners and running to a cylindrical box where the wires continued in two small vertical rectangular coils, again at right angles to each other. The movable coil was wound longitudinally on the vertical axle of the cylinder, the latter being turned by a hand wheel and the angle read off on a dial.* Small aircraft aerials are simply twisted copper wires, up to 150 ft. in length, and suspended from winding sheaves, several of which were on view. The short-range wireless telephone set exhibited had a range of 10 miles. The receiver valves were of the ordinary grid and cylinder type; the grids of the transmitters were formed of tungsten wire netting surrounding the axial tungsten filament. In the 0.25-kw. wireless telegraph set exhibited, the transmitter was of the standard Marconi synchronous spark type, giving a musical note corresponding to a spark frequency of 600 per second. The transmitting wave may be adjusted to any value from 300 to 600 m., and the receiving gear can be tuned for all wave lengths between 250 and 2,500 m. This cabinet type was designed primarily for ships requiring a set having a working range of 100 miles by day and twice that distance by night. Examples of the Marconi low-power telegraph sets for aircraft were exhibited; the two spark transmitters weigh only 13 lb. and 25 lb., without auxiliary gear, and have a range of 30 and 60 miles respectively. A continuous-wave transmitting set weighing, complete with all accessories, only 32 lb., and with a range of 80 miles, and a sensitive valve receiver of compact arrangement, weighing 17.5 lb. with accessories, were also exhibited.

Mr. Robert W. Paul, Newton Avenue Works, New Southgate, London, N. 11, exhibited electrical laboratory instruments, including a dial-pattern Wheatstone bridge with precision contact, the latter being cased in and the reading made through a glass window. An insulation and conductivity meter with a range of 0.00005 to 100 megohms was also shown; the generator gives 500 volts, and three scales and a pull switch with 9 positions corresponding to various multipliers and the different scales are provided. An auxiliary 2-volt accumulator has to be employed as well as the generator for very low resistance of from 0.00005 to 0.2 ohm. A pyrometer, in the form of a "Unipivot" milli-voltmeter, was shown with the scale divided into millivolts and temperatures.

Messrs. Evershed & Vignoles, Ltd., Acton Lane Works, Chiswick, W., showed a collection of instruments mostly variations of their well-known "Meggers." A resistance box, the "self-evident," is used with a bridge megger, and has four dials; the value of the coil in circuit in each is shown by a figure which is read through a window, thus, the row of figures gives directly the resistance in circuit. Ratios of 1 (with which it is possible to read to 1 ohm in 4,000), 10 and 100, are obtainable by movement of a switch. Other instruments shown included a conductivity meter reading to 2,000 ohms, a deflectional ohmmeter reading directly to 1,000 microhms, and an instrument of a similar type, but using a 3-volt battery in place of a generator, has a range up to 100,000 ohms. The "Dionic" water tester uses a conductivity meter to give the resistance of a column of water of definite dimensions from which the presence and quantity of inorganic impurities can be inferred. A thermometer immersed in the column of water, and which carries a pointer on a scale, gives the necessary correction for temperature variation. The thermometer reading is observed and the thermometer pulled up until the pointer is on the same reading on the scale, the alteration of the cross-section of the column due to the displacement of the thermometer then gives the temperature correction.

The Cambridge Scientific Instrument Co., Ltd., Chesterton Road, Cambridge, exhibited a 6-string Einthoven galvanometer in conjunction with a photographic clock-driven chart, which will show the time relation between occurrences on six different circuits at six different places. Various indicators were shown for use with thermo-couple pyrometers for the control of furnaces; a thread recorder, connected to two pyrometers, was shown, the reading being shown in two colours on the same chart. This instrument gets over all inking difficulties, and can be constructed to show the working of several furnaces in the manager's office.

The Foster Instrument Co., Letchworth, Herts., also showed indicating and graphic thermometers and pyrometers of the resistance type, and a "cold-junction" box for use with thermo-pile thermometers.

* Elec. Rev., June 6th, 1919, p. 673.

Messrs. Crompton & Co., Ltd., Chelmsford, exhibited a potentiometer, accessories, and a variety of measuring instruments for special purposes, which included paired ammeters and voltmeters with shunts, &c., as portable testing sets, and also for battery charging and similar uses. This firm has developed the moving-iron type of instrument for A.C. work in a number of forms.

The Westminster Engineering Co., Ltd., Victoria Road, Willesden Junction, N.W. 10, showed a number of useful "Westminster" enclosed type arc lamps and accessories for projection purposes. The smallest of these lamps working with from 2.5 to 4.5 amps. is available wherever a supply at usual pressures is laid on.

Ozonair, Ltd., 96, Victoria Street, London, S.W. 1, exhibited apparatus for purifying the air of living rooms, offices, &c., as well as the "Ozonair" system of ventilation as supplied to the tube railways, and apparatus for medical purposes.

The Western Dental Manufacturing Co., Ltd., 74, Wigmore Street, Cavendish Square, London, W. 1, exhibited dental instruments and appliances, including electro-pneumatic switchboards, instruments, &c. A complete "Wesdenco" electro-pneumatic equipment was shown with high and low voltage units for dental use to work off D.C. or A.C. supply mains, distributing high-voltage currents to the engine, reflector, steriliser, atomiser bottles and tumbler-heating unit, automatic compressor unit, &c., and supplying low-voltage current to the hot-air syringe, cautery, mouth lamp and root drier, &c. Perfected reflectors and a diffused lighting unit were also shown; the latter gives an effective and diffused illumination to the entire surgery without shadows, with most of the light directed downwards, and resembling natural light of day.

Dr. E. E. Fournier d'Albe, 10, St. James's Terrace, Regent's Park, N.W.8, exhibited selenium cells and some of their applications, which included selenium cells used with relays, for photographic work, the transmission of speech or musical notes along a beam of light, and tablets for use with the exhibitor's optophone, an instrument enabling the blind to read ordinary print, which we described last year.

(To be continued.)

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

L.C.C. Tramways Electrical Staff.

It was inevitable but unfortunate that among the series of items quoted in my letter of the 1st inst. the title "Sub-station Attendant" should have occurred. To ordinary people, it was obvious that I was merely pointing out an anomalous feature of a public undertaking, and this was never meant to be construed as an attack on promotion from the lower ranks or on individuals.

As a rejoinder, I am drenched by a torrent of abuse embodying a lot of assumption, from a person, "H. H. M.," who, apparently, is an appendage of some unfortunate trade union, and plaintive remonstrances from a Mr. E. W. Jones urging me to be a "sportsman" and smother my losses. In addition, Mr. E. W. Jones accuses me of being a disappointed L.C.C. employé, while the quixotic champion "H. H. M." drags me along the same path vociferously pelting me with verbal garbage. Both are presumptive, and both are horribly wrong. At the same time, I would inform Mr. E. W. Jones that a little time spent in the perusal of L.C.C. minutes in the local reference library will provide him with the information I possess.

Your correspondent "H. H. M." seems below ordinary standards of controversy, for besides his gutter gibes at technical knowledge which stamp him as being destitute of this necessary attribute of efficiency, he ignores the essential part of my letter, and seizes hold of a portion of one paragraph, tears it from its context, selects an item or two which promise a return for his championship, and boldly spits fire, dragons teeth, and abuse. In addition, he misquotes one salary cited, because the difference of £50 (+) made his refutation more complete. Apart from all this, I am presumed to be a man with a grievance—a kind of individual whom trade unionists long assessed at their value; an envious, spiteful, self-seeking, character, who fell over himself to get into some trade union. I rub my eyes and wonder whether I am being assailed by a normal person, or whether I have been mistaken for some enemy of "H. H. M."

In a concluding paragraph I am urged to pack up my grievances and take them to "H. H. M.'s" Trade Union Tribunal, where this dispenser of authority and justice will investigate. What!

Really, Mr. Editor, somebody must be dreaming. I have no doubt whatever that L.C.C. officials are most unfortunate in their friends.

Jonah.

P.S.—I will risk exciting "H. H. M." by remaining anonymous.

[We cannot see that any useful purpose will be served by continuance of this correspondence.—Eds. Elec. Rev.]

Feeder Protective Gear.

In regard to Mr. C. W. Marshall's article on the Merz-Price system in your issue of August 8th, page 166, I should like to point out a fact which should be well known to those who have investigated these problems of protective gear. The scheme he indicates on fig. 5 of compensating for the capacity current in the pilot wire by means of an additional coil or winding on the relay in series with a capacity shunting the pilot wire was covered by the Whitcher-B.T.H. patents taken out in 1910, Nos. 17,177 and 21,662. I was fully alive for two or three years prior to that date to the possibility and advantages of quite a number of detailed improvements of this sort in pilot wire systems of protection; and some of them have been duly put on record as above, and have considerably exercised later patentees.

This method of compensation is quite good and sound, and, moreover, simple and cheap to apply either to new or existing systems. The last characteristic is its vital disability. It means nothing to speak of in the way of royalty or extra profit on apparatus, therefore it is not worth running commercially. To make money on protective apparatus you must be able to draw royalties on special cables or other costly apparatus; as well as to furnish a medium for special, extra or disguised profits for the makers on a modified staple product of high prime cost such as cables.

This affair of protective gear is very nearly out of the age of patent politics, yet old schemes keep reappearing on the Patent Office files with painful reiteration. It would be well if someone would settle down to the task of a really impartial and fully historical survey, so that users could discover more readily exactly what there is in it all and what devices they should use. They would be surprised, I expect, at the simplicity and the effective and economical character of the conclusions to which they would be drawn.

James Whitcher.

17, Victoria Street, S.W.1.
August 15th, 1919.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

Improved Rheostats.

We have received a new list of resistances which deals with improved models of tubular rheostats of the sliding contact type, manufactured by Messrs. Isenthal & Co., Ltd., Denzil Works, Willesden, N.W. 10. Incidentally it may be said that the manufacture of this class of apparatus was largely in the hands of German firms before the war.

The tubular type is the outcome of the demand for rheostats possessing considerable energy dissipation and moderate weight. The resistance carrier is solid drawn steel tubing of suitable diameter and length, fire enamelled and suitably mounted; for high voltages the resistance wire may be still further insulated from the support by means of mica lapping. The resistance wire is superficially oxidised, enabling it to be wound without spacing between the turns; the oxide sufficiently insulates each turn from the next; it does not peel off, and the heating of the wire tends to improve it.

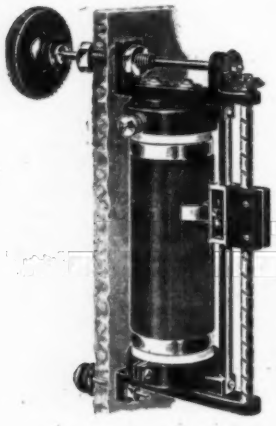

Fig. 1.—"Back-of-Board" Type Tubular Resistance.

Fig. 2.—Flat Slab Multiple Rheostat.

In the 30 mm. and 40 mm. sizes the tubes are clamped between two die-cast end flanges and the triangular guide bar for the slider is entirely relieved from all mechanical strain. For the 50 mm. and 60 mm. sizes the tubes are clamped at each end in die-cast end flanges, and the longitudinal strain is distributed between the tube itself and two steel tubular guide bars. All the rheostats may be supplied with graded winding, *i.e.*, instead of winding the whole length of the tube with one gauge of wire, the winding space may be subdivided into sections, each of which carries wire of different gauge, diminishing from the maximum section. In this way a very long range of adjustment and much finer regualtion is attained. In some cases the space at the front of a switchboard is limited, and it becomes necessary to mount the resistance itself at the back of the board, allowing only the operating spindle to pass to the front of the board. This type is made so far only in the 2¾ in. size of tube, as shown in fig. 1. If desired, an indicating device can be provided showing at the front of the board the position of the slider at the back of the board. These resistances vary in size from 9¾ in. (245 mm.) to 23¾ in. (595 mm.), and in weight from 4.4 lb. (2 kg.) to 6.6 lb. (3 kg.).

In slate rheostats, the resistance wire is wound on slate slabs, the edges of which are grooved, so that the wire forms a continuous narrow pitch spiral. All the rheostats are provided with terminals to enable them to be used either in series or shunt (potentiometer connection).

Universal rheostats may be employed with the two limbs entirely independent of each other, in two separate circuits, or by means of cross connections, combined fine and coarse adjustment of the circuit may be effected. The slider bar may also be marked in ohms or in simple divisions, to enable a certain adjustment to be quickly repeated.

Contact is made by a pivoted spring lever between each two slabs; in the "multiple" type, two or three levers, which for three-phase circuits may be coupled together, slide over engraved circular scales, and many useful combinations may be arranged. In this type according to the number of slabs in series the resistance varies from 2,400 to 7 ohms, and the amperes from 0.45 to 10. In the "rear" type the spindle of the lever is arranged to pass through a switchboard, and is provided with a hand wheel. In this type the resistance varies from 3,600 to 14 ohms, and the amperes from 0.45 to 10.

Wild-Barfield Electric Muffle Furnaces.

It is worthy of note that when Wild-Barfield electric muffle furnaces have been tested for production against gas-heated furnaces, the results have been in favour of electricity. This is claimed to be due to uniformity of temperature, simplicity of control, and absence of fumes and noise. Our illustrations mark a new production which should be of considerable interest. Fig. 3 shows a Wild-Barfield electric muffle furnace with the resistance cover removed, the heating chamber of which is 12 in. in diameter by 23 in. deep, the consumption being 9,500 watts and the maximum temperature 1,100 deg. C. The furnace is one of several designed and wound for 500 volts, and as far as the makers are aware they are the first electric muffles yet constructed for direct working on power circuits.

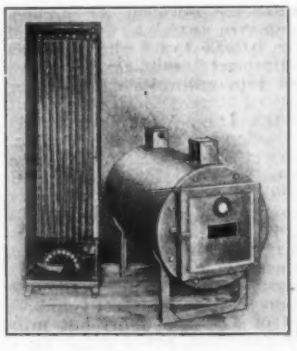

Fig. 3.—500-volt Electric Muffle Furnace.

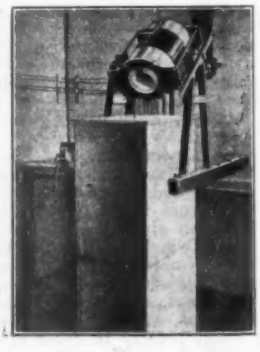

Fig. 4.—Automatic Hardening Furnace.

Fig. 4 shows an entirely new type of automatic furnace mounted on two spindles in bearings, for hardening sewing and hosiery needles, &c., in bulk. The furnace, shown half-tipped in fig. 4, is charged with the articles, and when the automatic indicator (not shown) announces the change point of the steel, the whole contents are tipped by means of a lever at the side of the furnace into a water tank as shown. A fresh charge can then be placed in the furnace and the operation repeated. The following table gives the various sizes of furnaces, the cost of energy consumed per hour at 1d. per unit, the maximum charge per heating, and the approximate output per hour of articles treated.

Size of heating chamber.	Cost, pence.	Charge, lb.	Output, lb.
4 in. diam. by 13 in. deep ...	1·4	2	7
6 " " 15 " ...	2·6	4	10
8 " " 17 " ...	4·2	10	22
12 " " 23 " ...	9·5	30	44

All the articles are hardened with a certainty difficult to attain with other processes, and the whole work can be carried out by unskilled labour. The furnace offers a new development for the use of electric power.

ELECTRIFICATION OF A THREE-HIGH MERCHANT MILL.

What is probably the largest electrically-driven non-reversing rolling mill in this country is that recently installed at the works of Messrs. Bolckow, Vaughan & Co., Ltd., Middlesbrough. The mill is of the three-high type, tilting tables being provided for elevating the plates up to the higher pair of rolls. With such a non-reversing mill, a flywheel with a large amount of stored energy can be used, so that a smaller motor is required than with an Ilgner set, and, in addition, the efficiency is higher.

The motor is a 3,000 (normal) B.H.P. "Witton" motor, and is designed for running on a 2,400-volt, 60-cycle, three-phase circuit, at a normal speed of 514 R.P.M. The guaranteed efficiency of the motor is 95 per cent. at full load, 94·5 per cent. at three-quarter load, and 93 per cent. at half-load; at the same loads the power factor is 85 per cent., 80 per cent., and 70 per cent. respectively. The overload capacity is not less than 25 per cent. for two hours without undue heating, and the machine will stand an overload of 100 per cent. for short periods without injury.

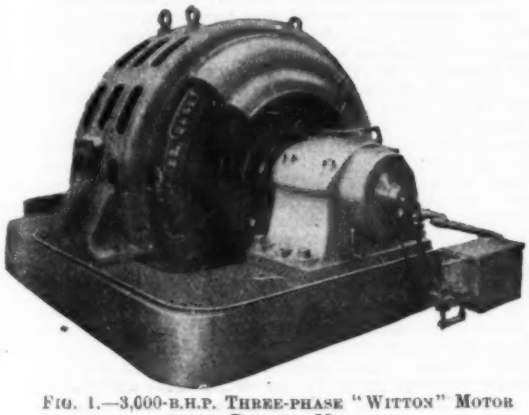

Fig. 1.—3,000-B.H.P. Three-phase "Witton" Motor for Rolling Mill.

The construction of the motor, fig. 1, is particularly substantial, the shaft being 12 in. diameter in the bearings. The latter are of the pedestal type, with cast-iron bearing bushes lined with anti-friction white metal; the weight is 5·25 tons. The bearing surface is very large, in order to ensure cool running at high speed. Oil gauges and draw-off cocks are provided, and every bearing is fitted with special hinged covers to allow easy inspection during the running of the machine. The lubrication arrangements are of interest; in addition to ring lubrication, flood lubrication is also arranged for by means of a small pump, chain-driven from the main shaft, and seen in the right-hand bottom corner of fig. 1. The bed plate weighs 7·25 tons.

The main motor shaft is coupled to the small counter-shaft on which the high-speed fly-wheel is mounted. This has an outside diameter of 11 ft. 10·5 in., a total weight of 41·7 tons, and the total energy stored is between 114 and 115 million ft.-lb. A 15 per cent. drop in speed enables the fly-wheel give out approximately 20 million ft.-lb. of energy.

The stator and rotor are both bar wound, the stator end turns being very solidly supported to prevent movement on sudden shocks. The rotor spider is of cast-steel. The slip-rings are of phosphor-bronze, proportioned to carry the current continuously, so that the machine can be used with a slip regulator. The weight of the stator is 13·5 tons, and the rotor 13·25 tons, the copper on the stator accounting for 3,200 lb., and that on the rotor for 2,200 lb.; the stator iron weighs 12 tons, the rotor iron 8·5 tons, and rotor steel 3 tons.

It is necessary for the motor to slow up on every load so as to enable the fly-wheel to do its share of the work. The fluctuations of load being very rapid, and as it is considered doubtful whether an automatic arrangement would respond quickly enough, it has been decided first of all to install a permanent grid resistance, and when the conditions of working have been fully noted, contactor gear can be installed and adjusted to vary the resistance automatically, according to the requirements of the load, should this be thought desirable.

Tappings are arranged so that more or less resistance can be connected easily in circuit. It is possible that the motor may be required to slow up as much as 15 per cent., and the resistances are intended to be large enough to dissipate 300 KW. continuously, although it is not likely that this will ever be required. Special arrangements for cooling are necessary, and the grids are mounted in a separate chamber with ventilating holes through the floor under each bank of grids. The chambers are continued upwards, so as to form a chimney above the grids, whereby a large volume of air can be drawn through the grids by natural ventilation. Natural draught was adopted so as to obtain the utmost reliability.

The motor is started by a liquid starter of special design, shown diagrammatically in fig. 2, which is of the rising liquid type, mistake-proof interlocks having been provided. On putting the starting switch into the "start" position, current is switched on to the squirrel-cage motor driving the pump, which begins to deliver liquid to the upper tank of the starter in which the fixed electrodes are carried. As the level of the liquid rises the motor runs up to full speed. When full speed is attained, the driver throws the starting switch into the full speed position, when the starter is short-circuited by an oil switch and the pump motor stopped. The liquid then runs back through the pump into the bottom tank, ready for the next start. An interlock is provided, so that the starting switch cannot be thrown into the short-circuiting "full-speed" position unless the motor has attained a predetermined speed. A step-by-step motion likewise prevents the short-circuiting switch being thrown straight away to the "full-speed" position.

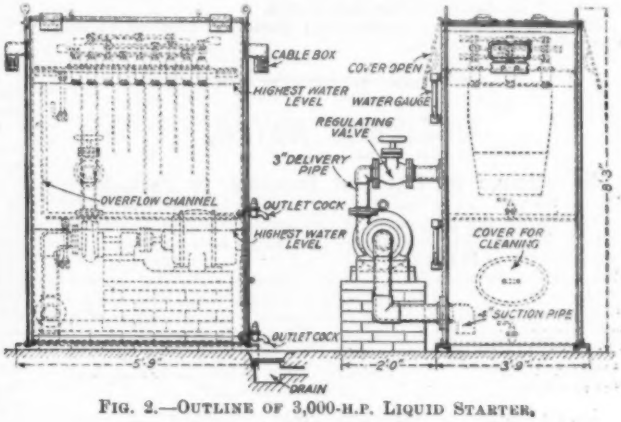

Fig. 2.—Outline of 3,000-H.P. Liquid Starter.

The short-circuiting switch is of the oil-immersed type, and the current dealt with is 1,200 amperes per phase. The rotating portion is on a mica-insulated drum, and is moved by means of an exterior handle into contact with the controller fingers.

The H.T. side of the motor is controlled by a standard G.E.C.

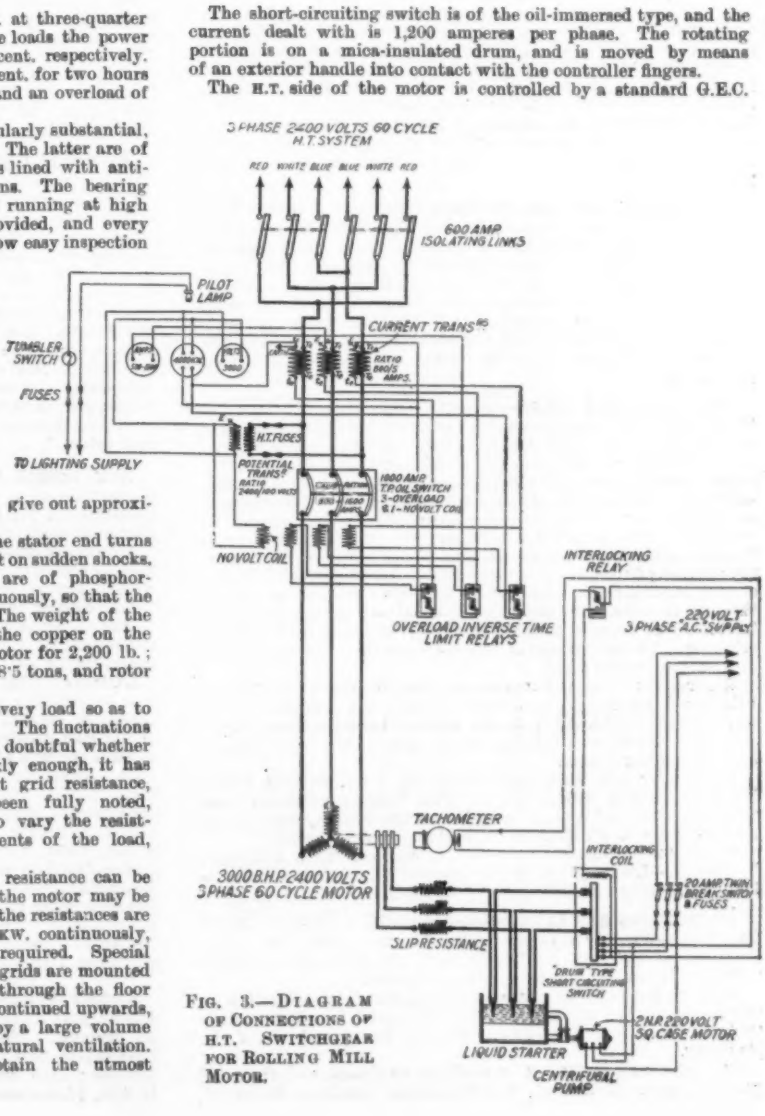

Fig. 3.—Diagram of Connections of H.T. Switchgear for Rolling Mill Motor.

boiler plate H.T. cubicle of the lock-up type, which forms the connecting point on a ring main, and is provided with two sets of isolating switches for isolating either of the two incoming feeders. It is provided with a free-handle oil-break switch with inverse overload and time-limit relays; ammeter, voltmeter, indicating wattmeter, and all the usual current and potential transformers. A complete diagram of connections is given in fig. 3. The system of interlocking deals with all possible mistakes except one, and that is that it should not be possible to close the oil switch with the liquid starter already short-circuited. This is guarded against by means of a mechanical interlock between the short-circuiting switch and the oil-switch panel. In the event of the oil switch opening circuit an interlocking bar comes into operation, which prevents it closing again unless the short-circuiting switch is brought to the "off" position. As the tank automatically empties, when short-circuited by the oil switch, the stator circuit can only be closed by means of the main oil switch when the maximum amount of resistance is in the rotor circuit.

The electrical equipment described above was supplied by the General Electric Co., Ltd.

BUSINESS NOTES.

Manufacture of Electrical Porcelain in Portugal.—During the past three years a thriving industry has been established in Oporto for the production of the porcelain parts of electrical wiring devices. The capacity of the factory is as follows:—H.T. insulators (up to 15,000 volts), 1,000 a day; L.T. insulators, 5,000 a day; small insulators, fuses, switches, rosettes, and other devices, 225,000 a day. Double this capacity is being planned for. Only a small portion of the necessary metal parts is being made locally, and business might be done in supplying these to the factory (Empreza Electro Ceramica, Villa Nova de Gayo, Oporto). The Americans are after the business, their attention having been drawn to the opportunity by their Consul in Oporto.

Lodge Dust Precipitation Plant.—*Tenders* for June 11th states that the plant for the white lead works at Launceston, Tas., being erected by the Lead Sulphate, Ltd., was arriving from Great Britain. The process of manufacture is purely an electrical one, and among the most interesting applications of this form of energy is the "Lodge" plant for precipitating from the fumes the impalpable dust not caught by the filter. The lay-out and the erection of the whole of the electrical plant was placed with the Electric Equipment Manufacturers Pty., Ltd. Our contemporary adds:—"Sir Oliver Lodge is now on his way from England to confer with the construction company in regard to this particular plant."

Profiteering and Export Trade.—In the course of his second reading speech on the Profiteering Bill, Sir Auckland Geddes said:—"Profiteering has a very profound effect upon the export trade. Wherever the home market presents a great opportunity of profit, naturally, as it is more easily reached and more easily observed, the tendency is to concentrate on the home market at the expense of the overseas market, and that is at all times for the country an evil, but at the present time it is a very great evil, perhaps the greatest single individual evil which flows from profiteering."

Catalogues and Lists.—Messrs. Isenthal & Co., Ltd., Denzil Works, Willesden.—Section I of their new list of resistances contains an illustrated description, with tabulated prices, weights and dimensions, of their improved models of tubular rehostats of the sliding contact types. The production of this class of apparatus was largely in the hands of German manufacturers before the war; as a result of their specialisation, their articles were extensively used here. This knowledge, together with the immense demand for these resistances during the war, induced Messrs. Isenthal, in the autumn of 1914, to devote all their energies to the development of such manufactures. The article that they are now offering in this list is claimed to be certainly equal, and in many respects (especially as regards mechanical design) superior to the foreign originals. An accompanying list particularises the firm's slate rheostats in various types.

Messrs. Dictograph Telephones, Ltd., Denman Street, London Bridge, S.E. 1.—Brochure got up in an effective and attractive way, pictorially getting home with the story of the advantages obtainable in a business establishment by using their "Dictograph" inter-conversing system.

Automatic and Electric Furnaces, Ltd., 281-283, Gray's Inn Road, London, W.C. 1.—No. 13 "Heat Treatment Bulletin" contains an abstract of a paper read before the Faraday Society, last month, by Mr. L. W. Wild, on "The Magnetic Sclerometer."

Waltham Manufacturing Co., 2, Jackson Road, Holloway, London, N.—Leaflet giving particulars and prices of the Waltham lantern arc lamps, hand and automatic feeds.

Dissolutions and Liquidations.—Engine Development Co., Ltd.—Winding up voluntarily for the purpose of reconstruction as the Still Engine Co., Ltd. Mr. H. Peake, secretary, 7, Princes Street, Westminster, S.W., is liquidator.

British Coalite Co., Ltd., and Coalite, Ltd.—Winding up voluntarily for the purpose of amalgamation with Low Temperature Carbonisation, Ltd. Liquidators, Mr. H. Bacon and Mr. J. H. Macaulay.

Bauer, Imrie & Slack, consulting engineers and chartered patent agents, 72 and 74, Cannon Street, London.—Messrs. C. Bauer, H. Imrie, and D. H. Slack have dissolved partnership. Mr. Imrie will continue the business on his own account, and will attend to debts.

Ferguson, Pailin & Co., Ltd.—Meeting called for September 20th at 49, Spring Gardens, Manchester, to hear an account of the voluntary winding up from the liquidator, Mr. C. S. Croasdale.

Vulcanised Fibre, Ltd.—Meeting called for September 25th, to hear an account of the winding up from the liquidator, Mr. Colin Cooper.

Trade Announcements.—Correction.—In our last issue we mentioned certain developments in the business of the London Electric *Firm*. This was a mistake, as it should have read London Electric *Stores*. The paragraph in no way concerns the business of the London Electric Firm, of Croydon.

Messrs. Hamilton, Foulds & Co., of Glasgow, have appointed Messrs. Bromell Patents Co., Ltd., of 12, Bath Street, Liverpool, sole representatives for the sale of their W.H. motor starters in the district comprising Liverpool, East Lancashire, and Cheshire.

Works in Rayne Road, Braintree, have been opened by Messrs. Gordon & Cox, electrical engineers.

The Sterling Telephone and Electric Co., Ltd., have opened a branch office at 8, Park Place, Cardiff, under the management of Mr. W. Blogg.

Messrs. Napier-Kimber, Ltd., have disposed of their electrical contracting interests to Messrs. Troughton & Young, of Knightsbridge, and will concentrate their attention entirely upon wholesale business. All communications for Messrs. Napier-Kimber should in future be addressed to 109, Great Portland Street, W. 1, unless they relate to Yorkshire and Lancashire, in which case they should go to the usual branch at St. George's Hall, Bradford.

Italian Companies.—The capital of the Fiat Co. has been increased from 100 million to 200 million lires, at a special general meeting just held in Turin, for the purpose of transforming and modernising many of the present shops, with a view to efficiency and economical output and the consequent lowering of the price of cars. Other work to be carried out comprises an increase in electrical power for the rolling mills and steel works held by the Fiat Co., and producing exclusively for the Fiat motor factories.

For insulating tubes and similar accessory material Italy was exclusively dependent on Germany before the war. To remedy this condition of things a group of Milan manufacturers have formed a company, with 800,000 lire capital, under the style of Società Anonima Italiana Tubo Isolante (S.A.I.T.I.), and will manufacture the Bergmann tubes in steel, aluminium, iron, lead, and copper. Its works are situated in the Commune of Bresso, near Vallassina.

Electrical Goods for S. Africa.—In its issue of July 12th, the *South African Mining and Engineering Journal* says:—

"The delay in the forwarding of electrical goods from the coast still continues, to the annoyance and inconvenience of merchants, who have now been expecting stocks for some three weeks past and are still awaiting same. The difficulty appears to be in the provision by the Railway Department of the requisite trucks. Consequently all electrical materials are very scarce indeed, more particularly tubing, of which Johannesburg appears to be absolutely bare. The general demand is good, but, under the circumstances, cannot be coped with. Country inquiries are also good, but business is, of course, limited owing to the scarcity of materials. Confirming our forecasts, lamps have receded 3d., and are now 2s. 9d., and, in view of the enormous stocks held in Johannesburg, may, now that the 'ring' no longer exists, go even lower in the near future."

New French Companies.—Le Téléphone Privé National is the title of a company formed at Paris, with a capital of 1,000,000 fr., for the manufacture, sale, and installation of telephone and electric apparatus and instruments of precision.

A company styled the Société Commerciale d'Appareillage et de Lampes Electriques Marque "Dor" has been constituted at Paris, with a capital of 50,000 fr., for the manufacture and sale of "Dor" electric lamps and electric apparatus.

Diaz et Arrault has been incorporated as a company, capital 100,000 fr., for the manufacture and repair, purchase and sale, of apparatus for the lighting of automobiles, boats, &c.

L'Office des Charbons des Secteurs Electriques is the title of a new undertaking which has lately been formed in Paris with a capital of £8,000, the object being to arrange for the purchase of the coal required by the various electric lighting undertakings in Paris through a joint office.

The following are companies newly formed:—Chararg et Cie, Paris, 200,000 fr., mechanical and electrical industry; L'Electro Construction, Paris, 225,000 fr., lighting, power, telephones, bells, traction; Société Anonyme des Anciens Etablissements Galey Frères, Paris, 2,000,000 fr., electric installations; Société des Forces Motrices de la Chantagne (Savoie), Paris, 500,000 fr.; Société Générale d'Electrification, Paris, 1,000,000 fr.; Société pour l'Aménagement du Haut Rhône, Paris, 200,000 fr., hydraulic and hydroelectric installations, at Grezin, Malpertries, Bellegarde, and Genissiat; Société Anonyme d'Imprégnation Depoteaux Télégraphique, Paris, 500,000 fr., telegraph, telephone, &c., posts.

Copper Prices.—Messrs. James & Shakespeare report:—August 19th: Copper bars (best selected), sheets and rods, £142, £6 decrease. Messrs. F. Smith & Co. report:—August 19th: Electrolytic bars, £114, £4 decrease; ditto sheets, £150, £4 decrease; ditto wire rods, £122, £4 decrease; ditto H.C. wire, 1s. 4½d., ½d. decrease.

The German Business Man in England Again.—The Home Secretary stated, the other day, that German business men were being admitted to this country when their presence here would be for the benefit of British trade. Conditions are imposed as to place and duration of visit, and they have to report changes of residence to the police. Repatriated Germans are not being permitted to restart their businesses.

Shortage of Petrol Cans.—One of the chief hindrances to the large distributing firms is the continued shortage of cans, so that, although there is a sufficient supply of motor spirit, quite equal to the present increased demand, the companies are handicapped in the matter of distribution. An appeal is made to motorists everywhere to return all empties as speedily as possible. It must be borne in mind that the manufacture of cans has been practically at a standstill during the past two or three years, whereas an enormous quantity has been scrapped, which it will take time to replace.

Book Notices.—*Reconstruction and Foreign Trade.* By Ernest T. Williams, M.I.E.E. London: James Selwyn & Co., Ltd. 2s. net.—The importance of foreign-trade expansion to the British nation is not a new subject in the pages of the Electrical Review. We were urging it long years ago when others were content to scoff, and one of our useful advisers abroad in those days—and we had many of them—was the author of the book that lies before us now. Mr. Williams's name has, during the war, been familiar to our readers in other connections, notably the subject of national reorganisation of electricity supply, but before that, when he was following his technical electrical avocation in several distant spheres, he was enabled to study the British position in relation to foreign trade possibilities, and his proposals were placed before our readers in the form of articles. It is hardly possible for a trained electrical man with an aptitude for business, and a desire to assist the nation of which he forms a part, to travel far abroad without having a great vision of the vastness of the trade opportunities that the world presents for manufacturing activity in the works of the Old Country. Everybody is saying, in these days, how pressing is the need for British export trade expansion to enable us to avoid disaster. Unfortunately it has not seemed to be possible to induce our statesmen to exhibit extraordinary enthusiasm regarding the possibilities or the necessities of the situation, so far as national policy is concerned, and the workers too frequently seem to understand so little about the bearing of the matter upon their immediate as well as their future interests. The author has brought the same originality and thoroughness to bear in his handling of this subject of reconstruction and foreign trade, as characterised his constructive proposals respecting electricity supply. He is greatly impressed with the importance of foreign trade to the British Empire, and with the urgent need for reform in current attitude toward the subject. He elaborates a scheme for an organisation for effecting such reform—an Empire scheme being stated in detail, and a number of considerations that arise therefrom. The book is hardly one to do justice to in, say, a two-penny 'bus ride down to Whitehall; it requires seriously sitting down to without distractions, in order that the various diagrams of trade as it has been, and as it should be, and the other diagrams explanatory of the different branches and areas of the organisation, may be fully understood. One also has to consider how far it would dove-tail in with or absorb other already established private industrial organisations, assuming that they were willing to co-operate. The opening page makes its appeal to the Premiers and business men of the Empire, and indicates that first a business organisation controlled by business men possessing foresight and full of action, is required; secondly, that such an organisation should have Government backing and support, but no interference, and that it should exhibit energy and enterprise; thirdly, that there should be business experts to assist in expert business, and these would effect organisation and development. The scheme would cost a great deal of money of course, and a chapter is devoted to financial considerations. We have been spending money with a prodigal hand, but we have got to spend millions more yet if we are going to save what remains and to build up a strong and prosperous industrial future for our race. Mr. Williams's proposals are ambitious, and we may be excused if our faith fails us when we consider them in the midst of our present troubles, but we hope the pamphlet will be widely read, and by the right men, for nobody can study the subject at all closely, under the influence of the author's optimism, without gaining a very large idea of the trade possibilities of the world.

Technical Reporting. Centenary Edition. By Thomas Allen Reed. London: Sir Isaac Pitman & Sons, Ltd. Price 3s. 6d. net.—This little book, with its, perhaps, too comprehensive title, consists of a large number of phonographic abbreviations for words and phrases met with in reporting scientific and other technical subjects. They are classified under the headings of "Mechanical," "Medical," and "Legal." In the first section are a number of electrical expressions and many that one hardly associates with mechanical engineering—such, for instance, as ammoniacal liquor. It would, of course, be easy to multiply technical expressions manifold, and then such a list would be far from complete. Anyway, the book is calculated to imbue the budding professional shorthand writer with respect for, if not awe at, the kind of thing he is up against in tackling technical work. It would take a good deal more than any text-book, however, to make a technical reporter in the full sense of the term. Even in reporting and professional shorthand writing specialisation is inevitable, and, frankly, we doubt if a perusal of the list of phrases given in this book would be of much value to the ordinary newspaper man who aimed at fortifying himself against the emergency of being called upon suddenly to deal with a technical subject, as is rather suggested in the introduction. For use by the class teacher we can well imagine the book being extremely serviceable.

The Wireless Press, Ltd., is about to issue what is described as the first independent British journal devoted entirely to the technical side of radio-communication. It will be the *Radio Review*, will appear monthly at 2s. 6d., and will be under the editorship of Prof. G. W. O. Howe, D.Sc., M.I.E.E., with Mr. P. R. Coursey, B.Sc., as assistant editor.

"Annual Report of the British Chamber of Commerce, Paris, for 1918." Paris: 6, Rue Halévy.—We commend this report to the notice of all who are interested in French trade and industry. There is a full list of members of the Chamber, and the British concerns that they represent.

"The Central." The *Journal* of the Old Students of the City and Guilds Engineering College. Vol. XVI, No. 45. June, 1919. Price 2s. 6d.—This issue contains articles on chemical engineering, by Capt. C. J. Goodwin, the "Le Rhone" Aero Engine, by R. A. S. Thwaites, and the determination of the amount of sand in suspension in water, by J. J. Gibbs. The report for 1915-1918 of the "Old Centralians" is enclosed.

Bankruptcy Proceedings. — Cecil Saul Nathan, 97, New Bond Street, W.—Under this failure the first meeting of creditors was held on August 13th, at the London Bankruptcy Court, before Mr. F. T. Garton, Official Receiver. It appeared that the debtor, having been engaged for some years by the Brush Electrical Engineering Co., Ltd., in superintending and erecting machinery for their clients abroad, entered in August, 1895, into partnership with one Leo Sunderland, and carried on a contracting business as agents for the same company, taking offices at 39, Victoria Street, Westminster. They carried on the agency until 1902, when it was rescinded by the company, and the partnership was dissolved. During the same period the debtor carried on an electrical contracting business in his own name at the same address, but closed that down in 1910. He had also acted as director of a number of industrial companies, and in January, 1918, he was engaged by Associated Aircraft, Ltd., which appointment he held until the company went into liquidation last April. The debtor returns unsecured debts £1,253 and contingent liabilities £4,200. He attributes his insolvency to liabilities incurred on behalf of Engineering Proprietary, Ltd., of which he acted as director. The meeting was adjourned till August 22nd, to enable the creditors to elect a trustee and committee of inspection to wind up the estate in bankruptcy.

E. Cloney, tramway divisional traffic superintendent, 5, St. Albans Road, Parliament Hill Fields, N.W.—Last day for proofs September 2nd. Trustee, Mr. E. S. Grey, Official Receiver, Carey Street, W.C.

The 44-Hour Week and Foreign Competition.—As the outcome of an important conference of delegates of the Federation of Engineering and Shipbuilding Trades and the A.S.E., representing 46 Trade Unions with 1,750,000 members, held in London last week, it is proposed that a Committee be appointed consisting of six employers and six members of the Negotiating Committee, to investigate the economic effect of a 44-hour week throughout the engineering and shipbuilding industries, having regard to the methods of production and foreign competition. Further consideration of the application for a 44-hour week would be adjourned pending the report of the Committee. According to the *Financial Times*, what seemed to impress the Trade Union delegates as much as anything was the data furnished by Sir George Carter, chairman of the Shipbuilding Employers' Federation. Sir George Carter said that America had now greater shipbuilding facilities than we had; she had a greater volume of work on hand, and for the first time had cut into our foreign markets. She was improving with experience and her costs were falling, so that when we came to duller times in shipbuilding she would be able to outstrip us. Steel tubes were delivered free on board New York at £7 10s. a ton cheaper than we could make them here. Steel strips were being delivered free in this country from America £5 a ton cheaper than we could make them.

Auction Sale.—Messrs. P. Huddleston & Co. will sell by auction at Hammersmith on September 3rd the trade stock of a wholesale electrical accessories house. For particulars see our advertisement pages to-day.

The New Name of Westinghouse.—It was understood a few weeks ago that the British Westinghouse Electric and Manufacturing Co., Ltd., was to alter its name to the Vickers Electrical Co., Ltd. The *Times* states that an amendment was carried at the meeting adopting the title: The Metropolitan Vickers Electrical Co., Ltd. A motion confirming this change is to come before a meeting called for to-morrow, Saturday.

The Future of the Steel Industry.—Important questions concerning the future of the iron and steel industry in this country have been considered in London by the executive of the Iron and Steel Trades Confederation, under the presidency of Mr. John Hodge, M.P. The meeting discussed at length the question of foreign trade, with particular reference to American competition in the iron and steel trade. The view was held that the matter was one in which both workmen and employers should lay their cards on the table. Frankness with one another was required both in respect of the profits which were made in the trade and as to whether the present prices charged by the manufacturers were justified. It was thought, moreover, that there should be improved methods in respect of the organisation of the industry—for instance, in the allocation of orders, the pooling of freightage, and more readiness on the part of the employers to adopt up-to-date appliances for the manufacture of iron and steel.—*Daily Telegraph*.

Demand for Telephone Material in Brazil. — The United States Consul at Porto Alegre draws attention to the fact that at that city, as well as Pelotas and Rio Grande, the telephone switchboards are practically worn out. They were supplied from Germany (Siemens-Halske). Plans are being made for the substitution of automatic telephones in Porto Alegre.

Lead.—MESSRS. G. CAWSON & Co., in their report dated August 16th, say :—

Prices have advanced about 15s. per ton all round. Prompt lead which closed last week at £24 5s., sold up to £25 5s., and closes at £25. September is quoted at £25 5s., and October £25 10s., November £25 12s. 6d. to £25 15s., and £26 paid for December, closing with sellers. Since there is very little lead to come in, there is no doubt that the stock here will continue to decline.

American reports show a considerable decline in output, besides a better demand for consumption. The situation in Australia is as unsatisfactory as ever, and nothing is being shipped. Japan and China have had to come to this market for lead, and have been buying in fair quantities. Mexico should supply more lead; unfortunately the position there is very unsettled, so that increased supplies from that country are very uncertain. Spain is producing less lead; some of the older mines are reported to be worked out. After the heavy stocks here are worked off, it seems that we may have a great shortage of lead later on. This contingency, however, is not likely to arrive before next year. Meanwhile, consumers would do well to keep their requirements fully covered.

MESSRS. JAMES FORSTER & Co., on the same date, say :—

Actual consumers are not inclined to anticipate their requirements towards the end of this year and early in 1920 by paying the premiums asked for shipment so far ahead, nor do we see any necessity for their doing so. "Controlled" lead is still obtainable at round about £25 5s. for fair quantities, and the authorities are allowing a little more latitude with regard to time for taking delivery. This is only reasonable in view of the difficulties in obtaining the metal at most of their stores.

Americans and the Stuttgart Bosch.—A Reuter dispatch from Berlin quotes the *Zeitung am Mittag* as saying that the Daimler Motor Co., in Untertuerkheim, has been sold to an American firm, and that American business men are also said to be negotiating with the Bosch Co. and other important industrial concerns in Stuttgart with a view to purchase.

LIGHTING AND POWER NOTES.

Accrington.—PROPOSED PRICE INCREASE.—The Electricity Committee is considering a revision of charges, having regard to the increased cost of coal.

LOAN SANCTION.—The M.H. has sanctioned a loan of £10,000 for mains and feeders and £5,000 for transformers. The Ministry has approved generally of the scheme for new generating plant to an expenditure of £70,000, but the formal sanction will be deferred until tender prices are ascertained.

Alloa.—Owing to the great expansion of lighting and power requirements, it has been agreed to separate the gas and electricity departments, which have hitherto been run conjointly, and to have a separate manager for each department. The works manager of the electricity department will have a commencing salary of £500.

Aldershot.—PROPOSED PRICE INCREASE.—The U.D.C. has applied to the B. of T. for consent to raise the maximum charge for electricity from 8d. to 1s. per unit.

Ayr.—PROPOSED LOAN.—The Secretary for Scotland is to be asked to authorise an increase of £20,000 in the Corporation borrowing powers in connection with the electricity supply.

Berwick-on-Tweed.—PRICE INCREASE.—The charge of energy has been increased for power by 30 per cent.

Bexhill.—PRICE INCREASE.—The price of electricity has been increased by 7 per cent.

YEAR'S WORKING.—The working of the Corporation electricity undertaking last year involved a deficit of £884. The decrease in units sold amounted to 58,720, which, at the average value of 5d. each, represents £1,223, or sufficient to have met the increased cost of fuel, wages, &c.

Blackpool.—MUNITIONS.—The electricity department during the war made 344,275 shells for the Army, weighing 9,500 tons. Besides paying for plant and equipment, there was a profit on the undertaking of £23,864.

Bolton.—LOAN SANCTION.—The Electricity Committee has received the sanction of the L.G.B. to borrow the following amounts :—£5,406 for mains, £23,208 for transformers, switchgear, &c.

PRICE INCREASE.—Consequent on the increase in coal, the Electricity Committee has decided that from the day of the increase in the price of coal the price of electricity to all consumers be increased by 0·2d. per unit.

Bootle.—PRICE INCREASE.—A further increase of 20 per cent., making 85 per cent., is to be added to electricity charges. Where charges are qualified by coal clauses, 10 per cent. is to be added, making a total increase of 35 per cent.

Bridlington.—PRICE INCREASE.—The T.C. has increased the price of electricity for lighting by 20 per cent. and for power by 25 per cent.

Bury.—PRICE INCREASE.—From October 1st next the price of electricity will be increased by 10 per cent. for tramways and lighting and by 20 per cent. for power purposes.

Chesterfield.—LOAN.—The T.C. is to apply for a loan of from £4,000 to £5,000 for new cable.

Clyde Valley.—BILL.—In the House of Commons, on August 11th, the Secretary for Scotland presented a Bill to confirm a Provisional Order under the Private Legislation Procedure (Scotland) Act, 1899, relating to Clyde Valley electrical power. The Bill was read a first time.

Continental.—FRANCE.—The Bill for the Canalisation of the Rhone and the employment of water power was introduced in the Chamber on August 9th. The cost of the scheme is estimated at 2,500,000,000 fr. (£100,000,000), and the total power to be obtained will not be less than the equivalent obtained from 5,000,000 tons of coal, or one-fifth of the coal production of France for 1918. It is estimated that the scheme will take 15 years to complete. The shares will be guaranteed by the State, which will probably appoint two-fifths of the members of the board of directors, and will have the right to select the President.

The damages caused by the war to French electrical undertakings are reckoned at amounting to 119,801,000,000 fr. Mechanical and electrical constructions and electrical works figure in this huge total for 4,460,000,000 fr., and hydraulic and agricultural installations for 66,000,000 fr.

ITALY.—The schemes for the electrification of Italian railways which the Administration contemplated before the war, aggregates about 5,000 km., and comprise the Ligure-Lombardo-Piemont, 930 km.; the Veneto, 1,279 km.; the Central Italian, 1,576 km.; the Italia Meridionali, 951 km.; and the Paolo-Reggio-Calabria line, 200 km., with other lines in Sicily. The total outlay on these works is estimated at 200,000,000 lire, spread over 10 years. The Association of Working Electric Undertakings takes exception to the Administration's intention to accord privileges to certain State or semi-State undertakings to carry out these works, and contends for the resort to private companies alone, on the grounds that any other course being likely to prove barren and costly.

GERMANY.—The effects of the coal miners' strike in Upper Silesia are being felt throughout the country. The Hamburg electric power station announces a restriction of supply by one-half from Monday last.

Darlington.—PRICE INCREASE.—The charges for electricity are to be increased as follows :—Lighting, flat rate, to 4½d. per unit; maximum demand rate, to 5d. and 1½d. per unit; theatres and picture halls, to 3½d. per unit; discount on charge for lighting to large power consumers not to reduce price below 1½d. per unit. Electricity supplied for heating purposes, to 1½d. per unit. The charges for power are to be increased by 10 per cent.

LOAN.—Application is to be made to the M.H. for sanction to borrow £10,000 for new mains.

Dewsbury.—PRICE INCREASE.—Electricity charges have been increased as follows :—Lighting, from 35 to 40 per cent. over pre-war rates; rateable value, from 40 to 50 per cent.; power and heating, from 60 to 75 per cent.

Dundee.—PRICE INCREASE.—The price of electricity is to be increased by 10 per cent. to meet the rise in the price of coal.

HYDRO-ELECTRIC SCHEME.—A proposed scheme, involving an expenditure of at least a million pounds, to utilising the water possibilities of the Tummel Valley, which has already been under the consideration of the Government, is to be reported upon. The question was raised by Mr. H. Richardson, the general manager and engineer of the Corporation Electricity Department, who reported that owing to the constantly-rising price of coal, the question of some definite settlement being come to on the advisability of using the Tummel Valley for electrical purposes was now imperative. He had gone carefully into the matter, and he himself did not fear the responsibilities, but he considered that the matter was of such importance as to warrant the co-operation of outside expert opinion. The Corporation is spending a quarter of a million on the Carolina Port extension.

Eastbourne.—YEAR'S WORKING.—The annual report for the year ending March 31st last on the working of the electricity undertaking, shows an income of £35,012, against £39,221; expenditure, £26,249, against £20,862; gross profit, £8,763, against £18,359; capital charges, £13,253, against £13,586; net loss, £4,491, against a net profit of £4,773 last year. The total units generated, 2,757,130; total units sold, 2,167,297; for lighting, 1,046,412; power, 607,325; heating, 408,746; cooking, 52,125; public, 52,689. The load-factor was 18·34 per cent., and the maximum load 1,349 KW. Total connections to mains, in equivalent of 30-watt lamps, are now 246,918, the number of lamps added during the year being 18,353. The number of consumers is 3,099, an increase of 165. The cost of generation has increased from 1·94d. to 2·66d. per unit sold. Although the total output has decreased by 9 per cent., the total quantity of coal used has increased by 13 per cent., to 7,424 tons, and the cost per unit sold from 0·85d. to 1·22d. As regards repairs, one mechanical stoker, worn out by length of service, was replaced by a new one. Seven new sub-stations have been built besides the enlargement of several old ones and equipment with transformers and up-to-date switchgear. The cost was met out of revenue. Street arc lamps, 102 in number, have been displaced by "half-watt" incandescent lamps, the lamps on the sea front being 1,000 C.P., and those in the other parts of the town 600 C.P. The old arc lamp lanterns have been adapted for these lamps. The conversion of the public street lamps on the route of the distribution mains from gas to electric was seriously delayed earlier in the year by the difficulty in obtaining materials, and later owing to the extraordinary number of applications received from new consumers for private supplies no labour

has been available to continue this work, which, however, will shortly be recommenced. Decreases are shown in the output for private lighting of 14 per cent., heating 29 per cent., and cooking 15 per cent. The supply for power has increased by only 4 per cent., before the Armistice the increase was at the rate of 25 per cent., and for the last quarter of the year under review there was an actual decrease in the output for power of 29 per cent., owing to the cessation of the manufacture of war material. The amount paid for imperial taxes was £3,825, an increase of £832. The total number of motors has increased from 295 to 321, the total H.P. connected being 1,157.

Elland.—Bulk Supply.—A Sub-Committee is to interview the Yorkshire E.P. Co. to ascertain prices and terms on which the company would supply the Council with electricity.

Falkirk.—Price Increase.—A new scale of charges for electricity has been drawn up, showing an increase of approximately 15 per cent. on the present rates.

Great Yarmouth.—Price Increase.—From September 29th electricity will cost 10d. per unit, and power 2½d.

Wages.—The E.T.U. having pointed out that Yarmouth was only paying 23s. 6d. plus 12½ per cent. above pre-war rates, instead of 28s. 6d. plus 12½ per cent., it has been resolved to pay the higher rate from the date of the award of the Committee on Productions.

Guatemala.—The electric lighting and power plant of Guatemala City (Empresa Electrica de Guatemala) was granted a 30-years concession, some 25 years ago, for electric lighting and power service in the city of Guatemala. The enterprise has always been a German institution. By Executive Decree of October, 1918, this property was taken over by the Guatemala Alien Property Custodian, and by later Decree was declared forfeited to the Guatemala Government, and nationalised. By Executive Order this property has now been leased to H. W. Catlin, New York, for the term of 10 years, at a cash rental of $40,000 per annum, together with the option of extending the lease for an additional like period. The Government concession under which the old company operated has been extended for the life of the contract and any prorogation. The lessee also becomes the preferred bidder in any future sale of the property. The plant was erected by the Siemens-Halske Co. (Berlin), and is hydroelectric, with a present capacity of 2,000 KW. at 4,000 volts, three-phase A.C., which is transmitted from the power station at Palin, 28 miles distant from Guatemala City. This is reduced at the local station to 1,000 volts for primary distribution over the city. The house service is at 120 volts. The entire pole line, both transmission line and for city distribution, is made of 9 and 10-in. I-beams. Some 16,000 incandescent lamps, 280 open-arc street lamps, and 2,000 H.P. motors are served. The leasing company also acquires the right to an incompleted additional water power and central station at San Luis, about 6 miles from Palin, the present operating station which, when completed, will give an additional 3,000 KW. There is much demand for additional light and power service in that city. The plant, as it stands to-day, has an estimated valuation of $1,000,000, and the cost of completing the auxiliary station is estimated to be in the neighbourhood of $300,000.—*Electrical Review*, Chicago.

Leeds.—Proposed Loan.—The E.C. is applying for sanction to borrow £20,000 for services and £15,000 for meters.

In view of the proposals contained in the Electricity (Supply) Bill, the Finance and Electricity Committees are not prepared to support the suggestions contained in the report of the Yorkshire Electricity Supply Linking-up Committee.

The chairman and deputy-chairman of the two Committees, with the town clerk and manager of the electricity undertaking, are to attend the forthcoming conference of the Yorkshire electricity supply authorities.

Leyton.—M.H. Inquiry.—A M.H. inquiry was held on August 7th relative to the application of the U.D.C. for a loan of £17,502 for works for a bulk supply of electricity for Walthamstow. The L.G.B. had refused a loan for new plant on the ground that it was going to have a big central station.

London.—Islington.—Owing to the increased cost of coal, further increases in charges for electricity are to be made.

Matlock.—We understand that the statement concerning water power on page 111 of our issue on July 25th was incorrect.

Montrose.—Price Increase.—The price of electricity for power is to be increased by an additional 25 per cent. upon the present charges.

Norwich.—Price Increase.—To meet the advance in the cost of coal, another 20 per cent. is to be added to all charges for electricity, making a total increase over the pre-war standard of 60 per cent. for lighting, and 70 per cent. for power. The charges for meter rent will be subject to 60 and 70 per cent. respectively.

Rathmines.—Price Increase.—The price of electricity is to be increased to 8d. per unit.

Stourbridge.—Price Increase.—The Midland Electric Corporation has informed the B. of G. that the price of electricity has again been increased, bringing the cost to 115 per cent. above pre-war prices.

United States.—The Duquesne Light Co., Pittsburg's central station organisation, has made arrangements for floating a $25,000,000 30-years bond issue, the bulk of the proceeds of which will be used for building a big new power plant at Cheswick, Pa., of such capacity that it can supply all the electrical power needs of the Pittsburg district for an indefinitely long time in the future. According to the *Electrical Review*, Chicago, this plant will be along the Allegheny River, with abundant supplies of water and fuel. During the war a comprehensive survey was made by engineers of the War Department of Pittsburg's probable power needs, and it was estimated that the probable maximum demand was equal to 556,000 KW. The power plant of the Duquesne Light Co. has now a capacity of more than 156,000 KW. Transmission lines will be erected to reach every vital part of the Pittsburg district, and to connect various power plant and sub-stations in such a way that uninterrupted electric service will be assured at all times. The Duquesne Light Co. now has 85,000 customers, seven generating stations, 163 sub-stations, 7,375 miles of electric conductor, and almost 1,000 duct miles of underground conduit.

TRAMWAY AND RAILWAY NOTES.

Birmingham.—Bill.—On August 8th, in the House of Commons, the Corporation Tramways Bill, from the Lords, was read a third time.

Brazil. — Railway Electrification. — Government approval has been accorded to the Central of Brazil Railway for the electrification of its suburban lines and of the main line from Barra to Pirahy. The system will be H.T., D.C., and power will be taken from the existing power station. The cost of rolling stock, sub-stations, aerial lines, &c., is estimated at about £850,000.

Burnley.—Extension Abandoned.—The Tramways Committee has intimated its desire to withdraw the proposals to extend the system at a cost of over £140,000, as it would be impossible to obtain supplies at a figure which would render it possible for the department to take on the extensions as a paying concern.

Clifton.—Extensions.—Mr. Edwardes, of the South Lancs. Tramways Co., and representatives of the Kearsley D.C. are to join the deputation from Farnmouth to the Swinton and Pendlebury D.C. to urge that a short length of tramway between the Clifton boundary and the Salford system be constructed, so as to make a through connection between Manchester and Bolton.

Continental.—France.—It is intended to set up a system of electric towing of boats on part of the Canal de la Marne and the Rhine, and tenders were recently invited for the purpose. The overhead supply system will be adopted, the electric tractors running on a permanent way, with suitable sub-stations.

Tramway employés at Nice are on strike.

Spain.—American electrical engineers are interesting themselves in the announcement recently made by the Cia. de Tranvias de la Corunna, of its intention to proceed with the construction of the Corunna Sada tramway. Its length will be 11·4 miles, but an extension of 7 miles to Betanzos is to be carried out later. According to the American Vice-Consul in Corunna, the construction of this interurban line will probably mark the beginning of an important era of tramway construction in the district. One of the largest capitalists of Galicia, associated with an engineer who is an enthusiastic promoter of the Corunna-Santiago line, is reported to have purchased recently an important waterfall near Santiago for the erection of the power station to supply the necessary electricity.

Dearne.—Time Extension.—The Wombwell, Wath-upon-Dearne, Bolton-upon-Dearne, and Thurnscoe U.D.C.'s have applied to the B. of T. for an extension of time for the completion of the lines authorised by the Order of 1915, and for power to increase passenger fares.

Doncaster.—Services Resumed.—The municipal tramway services, suspended for three weeks owing to the Yorkshire coal strike, resumed running on August 15th.

Dundee.—New Cars.—Although the cost of material has risen greatly, the contractors who supply the Corporation tramways with new vehicles have agreed to fulfil an order for four additional cars to the list of those already ordered, without any increased charge per car on the original contract.

Egypt.—Strike.—Strikes have again broken out at Cairo. The tramways have ceased running, and other public services are threatened.

Glasgow.—Year's Working.—The annual report on the working of the Corporation tramway department for the year ending May 31st last shows unexhausted borrowing powers of £729,110 and capital expenditure of £3,880,300. Average length of single line open to traffic during the year was 198 miles. Total revenue was £1,531,320, against £1,412,635; working expenses, £1,177,119, against £951,063; war expenditure £72,370, against £93,120; net balance, £14,773, against £177,553. The car-miles numbered 25,581,547, against 26,261,231; passengers carried, 464,246,677, against 430,946,566; the number of units used was 39,984,597, or 1·56 per car-mile. Traffic revenue per car-mile 14·3d., against 12·8d.; working expenses per car-mile, excluding power cost, 10d., against 7·9d., including power cost, 11d., against 8·7d. Of the passengers carried 11·4 per cent. were 1½d. and upwards; 26·12 per cent. 1d., and 62·48 per cent ½d. passengers

Traffic receipts from 1½d. tickets and upwards, 27·36 per cent.; from 1d., 33·08 per cent.; and from ½d., 39·56 per cent. The KW.-hours generated reached :—A.C. 6,600 volts, 42,815,928; D.C. 500 volts, 439,702; D.C. 100 volts, 46,478; total, 43,302,108; supplied by electricity department (H.T.), 2,239,143; total issued from station, 44,728,166. Maximum load on station was 13,100 KW.; load factor, 39·68 per cent.; coal consumed per KW.-hour generated, 2·778 lb. From the depreciation and permanent way funds £31,950 was expended on track renewals; the amount added to the funds was £183,543, the credit balance being £449,006. The rates of depreciation are now as follows :—Permanent way, £700 per mile of single track; power and sub-station plant, 3 per cent.; cars, 5 per cent.; electrical equipment of cars, 5 per cent.; other rolling stock, 15 per cent.; bridges, 5 per cent. The general reserve fund stands at £31,004. During the year £91,913 was expended on upkeep of track in ordinary repairs; in addition, £137,394 was set aside out of revenue to the cost of track renewal. Ground has been purchased for the erection of a new depôt, but work cannot proceed till the end of the year. Cost of ordinary repairs to power plant was £9,158, and £14,377 was charged against revenue to meet depreciation. A new 500-KW. rotary converter has been installed at Partick sub-station. Cars in stock number 866; cost of inspection and repair of cars was £97,006, and £28,049 was charged to revenue to meet depreciation. The work of building new cars, interrupted during the war, has been resumed, and some new cars are in service.

London.—Derailments.—Owing to the derailment of a carriage of a south-bound train at Piccadilly Circus station, the Bakerloo tube service was disorganised on Saturday afternoon.

One man was killed and 18 persons injured, one of whom died later, by the overturning of an L.C.C. tramcar at the junction of Crowndale Road and Great College Street, St. Pancras, on Saturday afternoon. The car was rounding the corner when it left the rails, and swerving across the road, ran into some railings and overturned. The car was wrecked and the woodwork caught fire, due to the breaking open of two street cable junction boxes.

Tests were being carried out on Tuesday to ascertain the cause of the accident. The wrecked tramcar was examined at the depôt, and it was understood that it would be taken to the scene of the accident and subjected to certain trials. It is expected that the cause of the accident will be found in the failure of the electric brake.

Traffic Board.—Mr. Bonar Law said in the House of Commons, on Monday, that no decision had been come to by the Government regarding the appointment of a traffic board for London, as recommended by the Select Committee on Traffic. It was hoped to carry out some of the recommendations during the summer recess.

Manchester.—Women Employes.—Out of a total of 1,130 women and girls employed by the tramway department during the war only 24 women conductors now remain on the books, and, in addition, there are about a dozen trolley girls; practically all women labour will be dispensed with this month.

Norwich.—Tramcar Obstruction.—The chairman of the Magistrates at the Norwich Police Court, last week, imposed the full penalty of £5 on Edward Cooper, cab proprietor and driver, who wilfully drove his hackney carriage at an unreasonably slow pace along the tramway rails so as to obstruct tramcars. The defendant had been previously cautioned by the Chief Constable for a like offence.

Rochdale.—Training Disabled Men.—Several members of the T.C. urge that discharged soldiers should be paid whilst being trained as motormen and conductors. The Tramways Committee, however, feels that this is a matter for the Government. Of the 390 employés of the tramway department no fewer than 224 are ex-service men.

South Africa.—Strikes.—The Cape Town tramway strike, which broke out on July 19th, has now been settled, the men having obtained concessions in wages and conditions. The strike of the Port Elizabeth employés of the same company has been similarly settled.

Sunderland.—Year's Working.—The annual report for the year ending March 31st last, shows total revenue of £119,691; working expenses, £67,321; interest, £7,265; repayment of capital, £18,000; net balance, £27,105. Passengers carried numbered 26,251,700, and the total number of units used was 1,839,128. Receipts increased by £20,152; passengers carried by 1,210,540; car-miles run decreased by 103,988. Average traffic per car-mile was 21·4d., and average working expenses per car-mile, including power cost, 12·2d., excluding power cost, 10·1d. Amount remaining in reserve, renewals, and compensation fund, was £68,351.

United States.—Strike.—The second transport worker's strike within a week began at New York on Sunday last, when 14,000 employés of the Interborough Rapid Transit Co. went on strike, the company having refused to grant a 50 per cent. wages increase. The company runs practically the entire underground and elevated railway systems of the city. The men at the power houses also threatened to stop work. The decision to strike came as a surprise to the officials of the company, as the men had previously agreed to submit their demands to arbitration.

The strike ended at midnight on Tuesday after lasting 48 hours. The men have been granted a 25 per cent. increase in wages, but a legal inquiry has begun into charges of a conspiracy between the men and the company to bring about the strike to force an amendment of the company's charter with the city limiting fares to 2½d.

TELEGRAPH AND TELEPHONE NOTES.

Cable Delays.—Trouble with cables between this country and the Near East is still serious. In a recent case a cablegram dispatched from London to Greece arrived late, and in such a mutilated form that the business to which it related was lost. According to the *Times*, protest to the cable company seemed to be fruitless; the company pointed out that, owing to the serious pressure on the cable system, the message had been transferred to the postal authorities for transmission. At the same time it enclosed an extract from a letter received from these authorities stating that "it was frequently found necessary, both in this country and in France and Italy, to forward messages over a part of the route by post."

Another case is that of a telegram dispatched from Mazenne, France, on the 13th, which was delivered in London on the night of the 15th. The original French telegraph form had been sent by letter post, and on arrival in London stuck on to an English telegraph form, put into the usual orange envelope, and delivered.

Cable Rates.—To provide for the quicker transmission of market quotations and trade reports, and so improve the position of American merchants and manufacturers in their competition for the trade of the Far East, the Commercial Pacific Cable Co. has decided to accept cablegrams for urgent transmission to the Philippines, China and Japan. This new service will be subject to discontinuance at any time without notice, and the rate will be three times the ordinary rate from origin to destination.

The Eastern Telegraph Co. announces that the tariff for cablegrams between points in Great Britain and Hong-Kong, China, Japan, and the Philippines will be reduced 6d. per word, dating from September 1st, 1919.—*T. and T. Age.*

Canada.—It is reported from Ottawa that several long-range wireless telegraph stations are to be built in the Yukon territory by the Canadian Government.

A commercial wireless service has been established between Canada and Bermuda.

Czechoslovakia.—The Republic of Czechoslovakia (comprising Bohemia, Moravia, Silesia, and Slovakia) plans to remodel, enlarge, and re-equip its telephone system. For this purpose a mission consisting of representatives of the Department of Post, Telephones, and Telegraphs, and experienced engineers will be sent to the United States to study and report on the various systems, switchboards, apparatus, appliances, &c., and recommend what in their opinion would best suit the conditions in the new Republic. The ultimate object is to place contracts for a complete and thorough telephone system, providing service not only for the territory of the Republic, but also taking care of its future needs as important development of waterways and railways is destined to take place.—*T. and T. Age.*

Dominican Republic.—Wireless communication is now available to the public between the cities of Santo Domingo and Guantanamo, Cuba, and by cable from the latter place to the United States.

Finland.—It is reported from Helsingfors that the Council of State has approved an estimate for the erection of a 35-KW. wireless station at Sandhamm, close to Helsingfors, which is to be ready in a few months. It is calculated that the transmission range will be about 1,240 miles, so that the station will be able to communicate with London, Paris, and Berlin.

France.—As a protest against the French Government's action in lowering prices, 500 telegrams were sent by Paris salesmen to producers throughout the country stopping the shipment of food. The telegraphists refused to transmit them, and the matter was referred to M. Clemenceau, who ordered the telegrams to be withheld pending investigation.

Telephones for the devastated regions of France are being provided by the French Post Office out of the equipment bought from the American Army, which includes 273 exchanges, 25,000 instruments, and many thousand miles of wire.

Government Reuter Telegrams.—In a written reply to a question in the House of Commons, Colonel Amery states that in the last financial year the sum of £30,697 was paid to Reuter's Agency by the Ministry of Information in respect of Press cablegrams to Canada and other parts of the Empire, and that this payment was made in consideration for the dispatch of special items of news of Imperial interest, which would not have been cabled under ordinary commercial conditions. The services to Canada and other parts of the British Empire, adds Colonel Amery, are being carried on until October 1st next on a reduced scale; the estimated cost of these services for a whole year on the present lines is approximately £18,000. The arrangements to be made after October 1st are now under consideration.

Mexico.—The wireless station of the Port of Tampico was officially on opened June 1st. The station's day range is 500 miles, and the night range 2,000 miles.

Poland.—It is reported that a scheme is now under consideration by the Polish Government in Warsaw for the establishment of a central wireless station in the neighbourhood of the Polish capital. American financiers have already evinced interest in the project, and delegates from the Polish Government have been invited by private enterprises in the United States to discuss the matter; the delegates have already left for America on this

mission. Offers have been received from the German Government for the construction of the station, but, although the price quoted was some eight times lower than the figure given by other European countries, the proposals are being held in reserve pending the outcome of the negotiations in the United States.

Telephone Restrictions Removed.—From August 15th the use of languages other than English for telephone conversations has been sanctioned by the Postmaster-General.

United States.—During the late war a single order placed by the U.S. Signal Corps for a certain kind of insulated wire was in sufficient amount to extend 14 times around the earth. Over 1 million battery cells were used, and 285,000 vacuum valves for wireless amplifiers were supplied. Over 100,000 telephones for field use, 200,000 wire pliers, and 8,000 of one type of wireless apparatus were produced and shipped to France.

In the year 1914, before governmental restrictions were placed upon amateur wireless operation and experimentation, the value of the apparatus sold to amateurs in the United States amounted to $672,600.

Wireless Development.—According to the daily Press, officials at Marconi House promise some interesting developments in the near future. It is stated that wireless will do anything that can be done by ordinary telegraphy; any photograph which can be sent by wire can be sent by wireless as well. The method being perfected is the transposition of a photograph on to a metal plate. The electric transmissions will be made according to the rise or fall of the metal contours. It will be possible very shortly, it is said, for a wireless message to be transmitted direct from the receiver to a working typewriter, which will reprint the message at the rate of "100 words per minute."

In one day recently, in New York harbour, there were counted 97 ships equipped with Marconi wireless sets.

Wireless to Egypt.—According to the *Times*, Mr. Bottomley asked the leader of the House of Commons whether the Government was proposing to install between England and Egypt a wireless system based upon obsolete patterns which were being discarded by other countries. Mr. Pike Pease, Assistant Postmaster-General, said the proposed stations were not of an obsolete pattern. The system decided upon was adopted after full inquiry; Government experts had been consulted, and the best independent advice obtained. He was informed that stations in France and Italy employing a similar system had been extremely successful in communicating with the U.S.A. America had one station equipped with the Alexanderson alternator, and France was installing the Latour alternator at certain stations, but it was not proposed to dispense with the arc system in either case. The Government was advised that neither the American nor the French alternator had reached such a degree of development as to justify its employment in the Oxford and Cairo stations, which it was proposed to complete without delay. Mr. Bottomley inquired whether the types were not such as had long been discarded by the Marconi Co. as ineffective, and whether it was not a fact that the engineers constructing the stations had not had the remotest experience of long-distance wireless telegraphy, to which Mr. Pike Pease replied that he could not say as to the experience of the engineers, but the system was only adopted after the fullest inquiry by the experts of the Government.

Wireless Weather Reports.—The *London Gazette* of August 15th contains an Admiralty Notice to Mariners (No. 1,393 of 1919) in regard to wireless meteorological information to and from ships at sea. There is no change in the general arrangements for collection, transmission, and issue of information outlined in the previous notice (No. 880 of 1919), which is superseded by the present notice. There are, however, material changes in the schedule of wireless stations. The British stations at Poldhu and Cleethorpes are given as working. The station at Washington now issues bulletins at two fixed hours of the day instead of only one. New weather-reporting stations are notified as established at Annapolis, U.S.A., and for the Mediterranean at Rinella.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the Electrical Review *in which the "Official Notice" appeared.)*

OPEN.

Annfield Plain.—September 12th. U.D.C. Construction of an overhead L.T. electricity distributing system. (See this issue.)

Australia.—Sydney.—November 10th. City Council. Supply of electric motors. Particulars from Electric Lighting Department, Town Hall, Sydney.

Bedlington.—August 26th. U.D.C. Supply and erection of poles, cables, &c., in connection with the overhead street lighting of Cambois. Mr. H. G. Lester, clerk, 24, Grainger Street West, Newcastle-on-Tyne.

Croydon.—August 25th. Electricity Department. Construction of a cooling tower pond. (See this issue.)

Eccles.—August 25th. Electricity Department. Three 500-K.V.A., 3-phase, A.C. transformers. (August 8th.)

Edinburgh.—September 11th. T.C. Three 10,000-kw. turbo-alternators; six water-tube boilers, capacity 65,000 lb. per hour. (August 8th.)

Grimsby.—September 25th. Electricity Department. Two 1,000-kw. converters and D.C. and A.C. L.T. switchgear; E.H.T. switchgear and cubicles; coal and ash-handling plant; 30-ton electrically-driven travelling crane. (See this issue.)

Ilford.—September 8th. U.D.C. One 500-kw. rotary converter, transformer, and switchgear. (See this issue.)

Lincoln.—September 2nd. Corporation. One 25-ton overhead electric crane. (August 8th.)

London.—L.C.C.—September 2nd. Four electric tower wagons for the Council's tramways. (August 15th.)

Manchester.—September 2nd. Tramways Department. Tenders for supplies and general stores, including many electric items. (See this issue.)

Portsmouth.—September 2nd. Tramways Committee. 12 months' supply of stores, &c., including various electrical items. (August 15th.)

New Zealand.—Auckland.—City Council has decided to call for tenders for extensions to the generating plant, cables, &c., having decided to borrow £80,000 for that purpose.

Invercargill.—October 9th. One 1,000-kw., 3,300-volt, steam turbo-alternator, with condensing plant and switchgear.*

Stockton-on-Tees.—August 30th. District Fund, Gas and Electricity Committees. Six months' supply of articles and stores. (August 15th.)

Stoke-on-Trent.—Electricity Department. Cooling towers. (August 15th.)

West Ham.—September 9th. Electricity Department. Lead-covered paper insulated underground cables. (See this issue.)

*A copy can be seen at the Inquiry Office of the Department of Overseas Trade (Development and Intelligence), London.

CLOSED.

Australia.—Sydney.—On June 3rd the City Council, by 14 votes to 8, adopted the Electricity Committee's report, recommending the acceptance of the offer of the British Westinghouse Co., to supply one 8,000-kw. turbo-alternator, &c., by May 20th, at a cost of £59,500 (see Elec. Rev. August 1st, page 142). At the meeting of the Council, on June 17th, the Electricity Committee, according to *Tenders*, reported having received a letter, dated June 5th, 1919, from Messrs. Willans & Robinson, Ltd., stating that they had been informed that the Council had recently entered into a contract with the British Westinghouse Co., for the supply of a main generating unit, which contract was in derogation of Messrs. Willans and Robinson's rights under the correspondence between that company and the Council of 9th and 13th December, 1918. Having regard to the special conditions, 5, 6, 7 and 8, set out in their letter of 9th December, which was assented to by the Council, it seemed to them almost incredible that the Council should enter into any contract which would be a breach of the conditions to which they had referred. It was asked whether the information which had come to them was correct, as, should it be so, the company regarded the action of the Council not only as a breach of good faith, but a clear violation of the Council's contractual responsibilities. The company would be left with no alternative but to take whatever steps might be necessary under the circumstances to protect their interests.

The Australian General Electric Co. have submitted a claim for £417, on their contract made in March, 1917, for the supply of 25,000 50-c.p. metal-filament lamps, on the ground of increased cost of manufacture between the date of the company receiving the order and the date on which the British Government permitted the manufacture to proceed. The amount works out at 4d. per lamp. The Electricity Committee, on their engineer's report, recommend payment.

The Committee also recommend the acceptance of the offer of the British Westinghouse E. & M. Co., to supply, deliver and erect the steam piping for the 8,000-kw. turbo-alternator, at the actual cost to the firm, plus 10 per cent.—*Tenders.*

Ayr.—T.C. 500-kw. rotary converter. Vickers, Ltd., £2,119.

Leicester.—The Corporation has placed a contract with the English Electric Co., Ltd., for a 5,000-kw., 3,000 R.P.M., turbo-alternator set, complete with condensing plant and circulating water piping, &c.; also rotary converters, transformers, and E.H.T. switchgear, and a complete boiler-house equipment, including, in the initial stages, two marine-type Babcock water-tube boilers, each to supply 50,000 lb. of steam per hour at 200 lb. pressure, superheated 250°. The plant will be installed at the Aylestone power station of the Corporation, an old boiler-house being dismantled to accommodate the new boilers. The feature of this extension scheme is that the plant is so designed as to enable it to be easily transferred to the proposed super power station when necessary.

Spenborough.—Electricity Committee:—

Rotary converter, £1,498.—Phœnix Dynamo Mfg. Co., Ltd.
Switchgear, £265.—B.T.H. Co., Ltd.
Transformer, £350.—Brush Co., Ltd.

NOTES.

Hydrophones off the Shetlands.—An Admiralty notice to mariners states that six hydrophones have been laid in positions in Bressay Sound and approaches. The hydrophones are connected by cables to the western shore of Ness of Sound; the positions of these cables will be shown on new editions of charts shortly to be issued.

Patents and Designs Bill.—In the House of Lords, on August 14th, the second readings of the Patents and Designs Bill and the Trade Marks Bill were postponed till after the recess.

Miners' Safety Lamps.—It is stated in the *Times* that the Home Office Committee on Miners' Lamps is prepared to consider new suggestions from any source for improving the safety or illuminating power of safety lamps, and to examine and, if necessary, to test, any new devices or new types of lamps that may be sent to it by inventors. Communications should be addressed to the Secretary of the Committee, Mr. Edward Fudge, Home Office, Whitehall, S.W. 1.

Coal Economy in Australia.—The opinion is widely held in Australia, says the *Sydney Morning Herald*, that there is urgent need for the examination of the economic position arising from existing methods in the distribution and consumption of black coal. After a superficial consideration of the subject, the Advisory Council of the Institute of Science and Industry has appointed a Special Committee to make detailed inquiry into the whole question of black coal economy.

Faraday House Men and the War.—The War Service Record of past and present students of Faraday House Electrical Engineering College has been issued. In the "Foreword" Dr. Russell remarks that naturally many Faradians were engaged on engineering work of national importance at home, but the "Record" is limited exclusively to those who served with the British and Allied Forces. The principal space is devoted to notes concerning the contribution to Victory of men who made the supreme sacrifice. There are a number of photographs of men in this sad class. In other cases briefer mention appears. The frontispiece portrait is of Colonel Hubert Sparks, C.M.G., D.S.O., M.C., Croix de Guerre avec Palme, President of Faraday House O.S.A., of whose record the College is justifiably proud. The pamphlet, which consists of 52 pages, will be treasured by all who know, or knew, the students, or who still take an interest in their old training institution.

Electric Furnaces in U.S.A.—According to the American Electrochemical Society, the number of electric furnaces in use in the United States in the ferrous metal industry has increased within the past four years from less than 50 to upwards of 300. The use of electric furnaces in the non-ferrous metal industries, particularly for the melting of brass, is increasing rapidly. The production of calcium carbide alone requires upwards of one-half million continuous E.H.P., while the power required for electric furnaces for use in the United States is upwards of 300,000 H.P. The amount of electrical energy necessary in electrochemical processes makes them of prime interest to the central stations, and the Society holds the view that the majority of the large developments at present contemplated will be intimately associated with electrochemistry and electrometallurgy.

Colliery Youth Fined.—When a youth was charged at Bishop Auckland Police Court with having interfered with the electric signalling apparatus at the West Carterthorne Colliery, it was stated that men and boys employed in the pit obtained a ride on the travelling tubs by bringing two electric wires together, and automatically stopping the train until they mounted. Detection of offenders was difficult, but accused, who was fined 20s., was caught "red-handed."

A Technical Federation.—A natural corollary to the recent growth of professional associations operating as registered trade unions is the formation of federations of such associations. As we recently announced in these columns, one such federation has been formed in the Federation of Technical and Scientific Associations, in which are included the National Union of Scientific Workers, National Association of Industrial Chemists, Electricity Supply Commercial Association, and the Electrical Power Engineers' Association. The immediate object of the Federation, is to secure the recognition of the claims of the executive, administrative, and supervisory grades of the various industries, and to secure united action on matters of general interest affecting these grades. In our advertisement columns to-day will be found particulars of a coming meeting of the Federation, at which eligible associations are invited to be represented.

Old Centralians.—Now that the war is over, it is felt that every endeavour should be made to revive all the activities of this association, with a view to re-establishing its influence in the engineering world. All old students of the City and Guilds College who are out of touch with the Old Students' Association are particularly requested to write without delay to Mr. G. W. Tripp, Lyndhurst, Hayes Road, Bromley, Kent, the hon. secretary of the "Old Centralians."

South African Electrification.—A Reuter dispatch, dated Cape Town, August 18th, stated that Mr. C. H. Merz, the electrical expert from London, had arrived there for the purpose of investigating the electrification of certain sections of the South African railways and of advising the Government regarding the production of electric power in the Union generally.

A Curious Turbo-Generator Accident.—On a big central-station system there were six 10,000-KW. turbo-generators on one sectionalised bus operating in parallel with three 10,000-KW. and one 25,000-KW. turbo-generators on another section of bus, the two bus sections carrying about 45 and 55 per cent. of their ratings, respectively. At another station, tied into the above station, were four more turbo-generators carrying about 60 per cent. of their rated load. At a third station, tied in with the other two stations, three large units, of 20,000 KW. and above, were operating at about 70 per cent. rating.

One of the field end-plates of one of the 10,000-KW. vertical type generators became detached and fell in between the field and armature. This resulted in the coils of both field and armature being cut, causing a short-circuit on the 9,000-volt windings and the exciter side of the machine. The defective machine was cleared from the system almost immediately.

Directly following the burn-out of the unit and the disturbance created, several of the turbo-generators in the same station tripped out due to overspeed; a number of synchronous converters in various sub-stations on the system shut down. One rotary burnt up. The system began to hunt and persisted for about 18 minutes after the turbo-generator broke down, the frequency varying considerably above and slightly below normal, and the voltage going from 7,000 to 8,800 volts in heavy swings. The wattmeters on the tie-lines between the three generating stations swung continuously from one end of their scales to the other, indicating heavy interchange of current between stations. After this had continued for about 18 minutes conditions suddenly quietened down, although for no apparent reason, and the system pressure rose to 9,400 volts, about normal.

It was then found that the reactances in the tie-lines between stations had been so hot as to oxidise at the surface of the cables (they were of the bare cable, concrete core type), and the insulating compound on the frame-work was blistered. Tie-line ammeters and wattmeters on one end of a tie-line were badly damaged. It was later discovered that one tie-line solenoid-operated circuit-breaker and one high-voltage feeder circuit-breaker were in the half-open position, the solenoid of the latter being burned open and grounded. It then became known that the negative return from the oil circuit-breaker of one of the 10,000-KW. turbo-generators had grounded and burnt open, and that a dead earth had occurred on the exciter system.

One explanation of the cause of the 18-minute surge or hunting between the three generating stations is that the breakdown of the defective turbo-generator had resulted in a phase displacement between the three systems. As the systems were tied-in together, the reactance prevented sufficient synchronising current flowing between the systems to bring them into phase again, and the disturbance continued until the abnormal conditions subsided and the system attained its equilibrium again. Whether it was excess resistance or too much or too little reactance might be a moot question without investigation, of course.

The trouble on the exciter system was doubtless due to the exciter system being subjected to high potential to ground, causing breakdown at several places, and possibly weakened insulation at others. Contact between armature and field when the field end-plate cut into the coils caused direct contact between the 9,000-volt system and the exciter system, and a consequent breakdown in the immediate vicinity.

The few salient features that have come to hand are sufficient to bring out the fact that hunting between systems is not yet a matter that can be fully guarded against under unexpected conditions. Moreover, the above incident shows that exciter systems may be subjected to direct contact as well as to induced high potentials; hence it might be well to give exciter systems the respect given to circuits of higher potential, and perhaps at the same time furnish a means at individual generators to prevent high potentials dissipating themselves promiscuously throughout the exciter system.—*Electrical Review*, Chicago.

Wood v. Connolly.—In our issue of May 30th a report appeared of proceedings in the Chancery Division, on May 23rd, before Mr. Justice Younger. These proceedings were adjourned to May 30th, and again to June 6th, when further evidence was filed against the defendants, Mr. William Connolly and the late Mr. James Connolly. We learn that on June 18th an order of the Court was made as follows:—

"June, 1919.

"Mr. William Connolly, Mr. James Connolly.

"WOOD *v.* CONNOLLY.

"Dear Sirs,—Referring to the notice of motion herein issued on my instructions against you, and the evidence which has been filed in support of such notice of motion, I hereby *unreservedly* withdraw all statements made therein which might in any way be construed to impute dishonesty on the part of any of you, and I agree to withdraw the notice of motion.

"Yours faithfully,

"J. M. HENDERSON,

"*Receiver of Connolly Brothers, Ltd.*"

Appointments Vacant.—Three Demonstrators in Electrical Engineering (one with knowledge of photometry), (£150 to £200 + bonus of £120 to £135), for the City and Guilds Engineering College; installation engineer (70s. + commission), for the Tynemouth Corporation Electricity Department; instructor in armature winding, for the Birmingham Municipal Technical School; car department superintendent (£225-£250), for the Dover Corporation tramways; junior shift engineer, for the Borough of Reigate Electricity Works; charge engineer (82s. 7d.), for the Paisley Electricity Department. See our advertisement pages to-day.

Institution and Lecture Notes.—Iron and Steel Institute.—The programme of proceedings for the autumn meeting (London, Institution of Civil Engineers, September 18th and 19th) has been issued. The president is Mr. Eugène Schneider. There is to be a general conference on "Fuel Economy," on the morning of September 18th. Several reports and papers on the subject will be read (report on "Fuel Economy in Steel Works," by Dr. W. A. Bone, Sir R. Hadfield, and Mr. A. Hutchinson; report on "Fuel Economy in Foundry Practice," by Mr. H. J. Yates; paper on "Fuel Economy in German Iron and Steel Works," by Messrs. Cosmo Johns and L. Ennis). On the following day a number of papers on other subjects will be submitted. Members are also invited to attend the "James Watt" Centenary Commemoration in Birmingham, commencing on September 16th.

Atomic Theories.—Prof. Bragg, Quain Professor of Physics at University College, London, lecturing on the above subject at the Woodbrooke School, said that men of science troubled themselves far more about how things were to be developed in the next few years than about the absolute. He claimed that the application of the Röntgen-rays to the discovery of flaws in aeroplane materials had saved many lives during the war. Referring to radium, he pointed out its peculiar nature, through the inability of man to control it. The man of science to-day sought to discover what language nature was talking, so that he might understand her. In an account of electrons, Prof. Bragg attempted to make the matter clearer by referring to what was really paid for when electricity was supplied. A company was not paid for electricity, which cost nothing—the company was paid for operating machinery to collect electrical energy.

James Watt Centenary.—The arrangements for the celebration at Birmingham of the centenary of the death of James Watt, on September 16th, 17th, and 18th, are practically complete. Not only has the Executive Committee secured the support of leading members of the British Government, the captains of industry, the heads of universities and colleges, and technical and other societies and institutions, but also assurances of influential support are coming in from interested bodies in America, France, and Canada. It is expected that representatives will be present from these and several other countries. The Committee is desirous of raising a sum of £250,000 towards the proposed international memorial to commemorate the centenary, which will consist of the endowment of a Professorship of Engineering, to be known as the James Watt Chair, at the University of Birmingham, for the promotion of research in the fundamental principles underlying the production of power, and the study of the conservation of the natural sources of energy; and the erection of a James Watt Memorial Building, to serve as a museum for examples of the work of James Watt and his contemporaries, Matthew Boulton and William Murdock.

The earliest pumping engine made for sale by James Watt will be under steam again on September 17th and 18th. Watt went into partnership with Matthew Boulton, at Birmingham, in 1775, and the Birmingham Canal Co. bought the engine in 1776; it was working regularly from that date until 1892—112 years of active life. The engine was re-erected at Ocker Hill, near Wednesbury, in 1898, and will be visited next month by engineers from all over the world who are attending the Watt Centenary Commemoration. James Watt was the first to conceive the idea of a decimal system of weights and measures in which the units of capacity and weight were in direct relationship to the unit of length, and the French introduction of the metric system followed. Appropriately enough, the site of Boulton & Watt's old works is now occupied by a large firm of weighing-machine manufacturers.

Parliamentary.—The following Acts have received the Royal Assent:—

Merchant Shipping (Wireless Telegraphy) Act, 1919.
Electric Lighting Order Confirmation Act, 1919.
Tramways Orders Confirmation Act, 1919.
Birmingham Corporation Tramways Act, 1919.
London Electric Railway Act, 1919.
Coal Mines Act.
City and South London Railway Act.
Clyde Valley Electrical Power Order Confirmation Act.
Restoration of Pre-War Practices Act.
Ministry of Transport Act.

The E.T.U. in the Midlands.—The *Birmingham Post* states that the Midland district of the Electrical Trades Union, which includes Birmingham, Walsall, Coventry, Wolverhampton, and many other towns, is about to inaugurate a new programme of wages and conditions. This means the repudiation of the existing national agreement, which, for some months, has not been generally acceptable. The demands that will be included in the new programme provide for the payment of £6 a week for 47 hours, and the repudiation of the agreement whereby the Ministry of Labour or Committee on Production review wages every four months.

Educational Grants for ex-Service Men.—Under the Government Scheme of Financial Assistance for the Higher Education of ex-Service Officers and Men, the total number of grants awarded by the Board of Education now amounts to 5,400, including officers and men in about equal proportions. The courses in respect of which grants have been awarded include more than 1,000 for Engineering and Technological Subjects, between 600 and 700 for Classics, Philosophy, and Literature, and about an equal number for Pure Science and Mathematics. Applications are still being received in large numbers, and are being dealt with at the rate of more than 200 a day.

Minimum Wages Commission Bill.—The Minimum Rates of Wages Commission Bill, which was introduced on Monday, authorises the appointment of Commissioners for the purpose of:—(*a*) Inquiring into and deciding what such minimum time rates of wages should be; (*b*) Inquiring into and making recommendations as to the methods and successive steps by which such minimum time rates of wages should be brought into operation, and the machinery by which they may be varied as and when occasion requires; (*c*) Inquiring into and making recommendations as to the granting of exemptions from the rates so fixed, and the methods by which such exemptions should be granted; (*d*) Making recommendations as to the legislation necessary for such purposes as aforesaid, and what amendments of the law, if any, are desirable.

The Commissioners may by order require the production of documents and the attendance of witnesses, those giving false or misleading evidence being liable to a fine of £50, or imprisonment for a term not exceeding one month. They are to have power to inquire into and report on any of the matters referred to the Commissioners under the Act, and such Committees may include, if the Commissioners think fit, persons other than Commissioners, and the Commissioners may delegate to such committees any of the powers conferred on them by the Act. The Commissioners may appoint an accountant to examine registers, wages sheets, balance-sheets, profit and loss accounts, and other trade accounts of persons engaged in the trade or industry of a district in which an inquiry is being held.

Whitley Electricity Supply Council for the North-West.—The *Manchester Guardian* states that an important Conference of Representatives of Electricity Undertakings in the North-Western Counties of England was held on Tuesday, at the Manchester Town Hall. Representatives of Trade Unions concerned with such undertakings were also present. The purpose of the meeting was to consider the advisability of all parties constituting themselves a District Council on the basis of the Whitley Report, under the parentage of the National Council for Electricity Supply. The Lord Mayor (Alderman Kay) occupied the chair. Both the employers' section and the representatives of the workers declared in favour of the scheme.

There are 80 electricity undertakings in the North-Western Counties. These undertakings are to be divided into groups according to size, and each group will nominate its representatives on the Council. The smallest section will thus have a voice in the proceedings. All questions affecting wages, hours of work, overtime rates, and holiday conditions will go before this Council for settlement. The Council will consist of 24 members, 12 representing the employers and 12 representing the workers.

Educational.—Royal Technical College, Glasgow.—The 1919-20 session opens on September 23rd; the College is affiliated to the University of Glasgow, and the degrees of the University in engineering and applied chemistry are open to its students. For particulars see our advertisement pages to-day.

Correspondence.—Co-operative Publicity.—We have received the following further letter on this subject:—

"Mr. P. W. Laverick's proposal that business firms of the same general class should carry on a co-operative publicity campaign is sound, and history has proved it so. In America, very many co-operative or centralised advertising campaigns have been, and are being, carried on. Examples of such campaigns are those of the California fruit growers, Pacific Coast hotels, Florida summer and winter resorts, southern pine timber growers, plumbing supply firms, various gas and electrical companies, makers of hot-air heating systems, jewellers, cattle-breeders' associations, wall-paper manufacturers, paint-makers, and so on.

"Wherever, and whenever, educational work must be done to produce a wider demand, it should be conducted by the class interest as a group—this in *addition to* the same sort of work by individual firms.

"It has been my fortune—or misfortune—to have been identified with numerous co-operative publicity campaigns. I cannot say that all of them have been successful, and the explanation of the failures has invariably been a too great reliance on the collective effort, with a suspension or non-use of simultaneous individual effort.

"If British makers of electrical equipments and machines will 'carry on' individually, with lusty and undiminished purpose, to sell their own merchandise; and if they will, at the same time, unite heartily *and for a long period* to maintain a co-operative publicity campaign in the Press of the markets where they sell or desire to sell, then they may hope for fine results. Of course, the copy and display of the advertising must be super-good, if maximum effects are to be a consequence. *And there must be a plan.*

"John C. Kirkwood.

"Industrial Publicity Service, Ltd.,
"London, *August 20th*, 1919."

The Ministry of Transport.—Sir Eric Geddes, who has just piloted through Parliament one of the most complex and important measures ever presented to it, has been appointed Minister of Transport, and, according to the *Daily Telegraph*, the headquarters of the new Ministry is to be temporarily, it is understood, at 6, Whitehall Gardens. Sir Eric is taking over, with their staffs, the Railway Department of the Board of Trade and part of the Public Utilities and Harbour Department, in the former being included railways, docks, tramways, canals, and light railways, all branches of the existing Railway Department. Sir William Marwood, K.C.B., at present Second Secretary to the Board of Trade, and previously head of the Railway Department, goes over to the new Ministry, and will be concerned mainly with inspection from the point of view of public safety.

German Control of Foreign Industries.—A Zurich correspondent of the *Times* says :—"In order to give a fair chance to the Germans to finance their necessary imports after five years of blockade, the Peace Conference in Paris decided not to confiscate German property in neutral countries. But this German property in Switzerland, Poland, Scandinavia, Argentina, Chile, and Spain, is very important for the enhancement of Germany's export to these countries. As owner and controller of departmental stores, electric finance companies, and so on, Germany guarantees in this way for her exporters future sales to these countries. Since the Peace Treaty was signed Germany's leading banks have been negotiating in Switzerland to obtain credits, but in these negotiations German creditors generally refuse the sale of any German-owned securities of a controlling character. There are buyers in the Swiss market of the Swiss-camouflaged German investments in Spain and South America which guarantee to the A.E.G. and to Siemens & Halske big orders in the future. German capital controls most of the Swiss departmental stores. . . . . German retail firms have a large network of branches in Switzerland, owning numerous buildings. The Germans prefer to renounce Swiss financial aid, which is badly needed, rather than sell this key position in Swiss economic life."

The 48-Hours' Week Bill.—The text of the Bill to regulate the number of hours of employment, introduced in the House of Commons by Sir Robert Horne, was issued on Tuesday. The Bill provides that the number of working hours (exclusive of recognised intervals for meals) in any week shall not in the case of any person to whom this measure applies exceed 48, and no person may in any week be employed in excess of the statutory working week. Power to vary normal hours or grant exceptions is given to the Home Secretary or Minister of Labour where a recommendation to that effect has been made to him by a Joint Industrial Council, Conciliation Board, or Trade Board, or an agreement has been arrived at between organisations of employers and workers in the class of employment in question.

Any hours worked by any person in excess of the statutory working week shall be regarded as overtime, and the decision as to the amount of overtime and the conditions under which it may be worked rests with the Home Secretary or the Minister of Labour. The payment for overtime shall in no case be at a rate of less than 25 per cent. in excess of the normal time rate, but any more favourable custom prevailing in any class of employment shall not be affected. The measure does not apply :—(*a*) To members of the employer's own family dwelling and working in his house. (*b*) To persons holding responsible positions of supervision or management, who are not usually employed in manual labour, or to persons who are in receipt of upstanding wages which have been fixed upon a basis of hours equal to or less than the statutory working week, and which cover overtime necessarily worked to enable such persons to perform their duties to their employers and to the workers under their charge. (*c*) To persons employed in a confidential capacity who are not usually employed on manual labour. (*d*) So as to prevent a person who ceases his employment with one employer and commences his employment with another employer, in the course of the same week, from being employed by the subsequent employer in accordance with the hours customarily worked by persons in his own employment.

The Act applies to persons employed in the service of the Crown or a public authority. In exercising his powers under the measure, the Minister is to have regard to any general recommendations made by the National Industrial Council. The Act is to come into operation six months after the Bill has been passed, but the Minister may, if he thinks fit, by Order suspend its coming into operation for any specified class of employment for a further period not exceeding six months.

Fatality.—Whilst two employés of Blackpool and Lytham Tramways Co. were on their way to work, last week, riding on the top of a car, the trolley pole snapped. One was thrown into the road, and received injuries to his head; the other was slightly hurt. The former, Thos. Hodgson (53), succumbed on August 15th.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station and Tramway Officials.—The Finance Committee of the Sheffield Corporation recommends that the maximum salaries for heads of the following departments be as follows: General manager and engineer, electricity supply department, £1,500 (to be reached by annual increments f £100); general manager, tramways and motor department, £1,500 (by increments of £100); deputy general manager electricity department, £850 (£50).

Mr. J. BRABY has resigned his positon as charge engineer with the Northampton Electric Supply Co., and has been appointed charge engineer to the Norwich Corporation electricity works.

Mr. F. GURNEY has resigned his position as chief assistant of the testing department of the Yorkshire Electric Power Co., having obtained an appointment with the British Westinghouse Electric & Manufacturing Co., Ltd.

Mr. E. R. FRY has recently resigned his position as assistant in the construction department of the Yorkshire Electric Power Co. to take up other duties.

Mr. C. F. WOLSEY, of the Lowestoft Corporation tramways department, has been selected for an appointment with the Sheffield Corporation tramways.

Doncaster Electric and Tramways Committee, last week, had before it 45 applications for the post of electrical engineer and tramways manager, rendered vacant by the appointment of Mr. E. S. RAYNER to Hull. The salary is £700. The applications were reduced to three.

Faversham T.C. has granted a war bonus of £50 a year to the electrical engineer (Mr. G. SOMMERVILLE) as from April 1st last.

On the occasion of his departure to take up the position of borough electrical engineer at Southampton, Mr. H. S. ELLIS was presented by the South Shields electrical department staff and employés with a travelling case and slide rule. Mrs. Ellis received an oxidised silver table lamp. Mr. George Robertson, station superintendent, presided at the farewell function, and Mr. J. C. Peterson, chief clerk, made the presentation.

Mr. CHARLES J. STONIER is resigning his position on the staff of the Dundee electricity supply department as sales engineer, to commence business on his own account as electrical and consulting engineer. He has been with the above department for 16 years.

General.—Messrs. Gent & Co., Ltd., inform us that Mr. A. E. EATS has resigned his position as London director and manager, and is no longer connected with the company.

Captain R. L. WOOD, M.C., Tyne Electrical Engineers, has been restored to the establishment of the R.E. Territorial Force, of which he was a supernumary whilst employed with the regular forces. He was commissioned in No. 4 Company of the Tyne Electrical Engineers on October 1st, 1914, and got his triple stars on June 1st, 1916. He saw much service overseas, and in May, 1917, was mentioned in dispatches and awarded the Military Cross for conspicuous courage in action.

Second Lieutenant C. ARMITAGE, Tyne Electrical Engineers, has been promoted to the rank of lieutenant.

Sir ERIC GEDDES has been appointed Minister of Transport under the Ministry of Transport Act (1919).

Mr. J. A. B. HORSLEY, A.M.I.E.E., has been appointed an Electrical Inspector of Mines under the Coal Mines Acts, 1887 to 1917.

Mr. H. G. WHITE has relinquished his appointment with the Sterling Telephone Co., Ltd., to take up the position of London manager for Messrs. Gent & Co., Ltd., of Leicester, whose London offices are at 25, Victoria Street, S.W. 1.

Obituary.—HERR. W. KUHLER.—The death is announced from Dresden, at the early age of 46 years, of Herr W. Kuhler, professor of electro-technics at the Technical High School, Dresden.

MR. J. SCHABERT.—The death has taken place of Mr. John Schabert, of Dukinfield, works manager of the Tudor Accumulator Co., after ten months' illness arising from lead poisoning. He was 51 years of age, and a native of the Grand Duchy of Luxemburg. He had, however, been resident in Dukinfield for 24 years, during the whole of which period he had been with the accumulator company. At the inquest the coroner said the factory inspector had stated that he was satisfied that the special regulations affecting such works had been observed. The coroner found that death was due to lead poisoning, and that the lead got into the deceased's system whilst carrying out his employment in the works.

Will.—The late Sir BOVERTON REDWOOD left £165,013.

NEW COMPANIES REGISTERED.

Astral Intensifier, Ltd. (157,890).—Private company. Registered August 13th. Capital, £5,000 in 10s. shares. To adopt an agreement with A. Graham France for the acquisition of a patent for a reflector or intensifier for an electric filament lamp, &c. The subscribers (each with one share) are: W. H. Timpson Bennett, 60, New Bond Street, W., merchant; A. Graham France, 64, Chancery Lane, W.C., engineer. First directors: W. H. Timpson and A. Graham France. Acting secretary: M. Patt. Registered office: 60, New Bond Street, W.

Constant Speed Spring Co., Ltd. (157,929).—Private company. Registered August 14th. Capital, £1,500 in £1 shares. Objects: to carry on the business of founders, wire drawers, mechanical wireless, electrical and mining engineers, manufacturers of and dealers in automobiles, cycles, and carriages, &c., and to adopt an agreement with H. B. Collins and T. F. Redington. The subscribers (each with one share) are: M. M. Gillespie, 4, Riverview Mansions, East Twickenham, engineer; H. T. Harrison, 11, Victoria Street, S.W., electrical engineer. The first directors are: M. M. Gillespie, H. T. Harrison, and H. B. Collins. The British Electric Equipment Co., Ltd., may, while holding any shares appoint 3 directors, of whom M. M. Gillespie shall be the first. Registered office: Amberley House, Norfolk Street, W.C.

A. B. Robinson & Son, Ltd. (10,569).—Private company. Registered in Edinburgh August 11th. Capital, £10,000 in £1 shares. Objects: to carry on the business of electrical engineers, sanitary engineers, plumbers, gasfitters, &c., and to adopt an agreement with A. B. Robertson, senr., and A. B. Robertson, junr. (partners of the firm of A. B. Robertson and Son). The subscribers (each with one share) are: A. B. Robertson, senr., Forresterhill House, Aberdeen, plumber; A. B. Robertson, junr., Forresterhill House, Aberdeen, electrical engineer. The first directors are: A. B. Robertson, senr., and A. B. Robertson, junr. Registered office: 200, Union Street, Aberdeen.

Hall & Stinson, Ltd. (157,901).—Private company. Registered August 13th. Capital, £3,000 in £1 shares. To take over the business of electrical engineers and contractors, dealers in apparatus and appliances, &c., carried on by H. G. Hall and B. Stinson at 237a, Glossop Road, Sheffield. The first directors are: H. G. Hall, 236 Carter Knowle Road, Sheffield; B. Stinson, 4, Dorset Street, Sheffield, electrical engineer. Registered office: 237a, Glossop Road, Sheffield.

Mansell & Ogan, Ltd. (157,912).—Private company. Registered August 13th. Capital, £5,000 in £1 shares (3,500 pref., 1,250 ord., and 250 founders). Objects: to carry on the business of factors of, agents for, and wholesale and retail dealers in, electrical apparatus and accessories, &c. The first directors are: M. Mansell, 15-17, Cecil Court, Charing Cross Road, W.C.; F. B. Ogan, 15-17, Cecil Court, Charing Cross Road, W.C. Solicitors: Ayrton, Biscoe & Knight, 10, Lancaster Place, W.C. Registered office: Gloucester Mansions, Cambridge Circus, W.C. 2.

Bullivants' Engineering & Contracting Co., Ltd. (157,885).—Private company. Registered August 13th. Capital, £5,000 in £1 shares. Objects: to carry on the business of general engineers and contractors, manufacturers of or dealers in wire rope tramways, mining and hauling plant and telegraph cables, aerial ropeways and apparatus, and any substances or goods in the manufacture of which wires or metallic ropes can be used, &c. The subscribers (each with one share) are: F. A. Bullivant, 72, Mark Lane, E.C., director of company; P. J. Bullivant, 72, Mark Lane, E.C., director of company; B. S. Bullivant, 72, Mark Lane, E.C., director of company; A. W. Bullivant, 72, Mark Lane, E.C., engineer. The first directors are: F. A. Bullivant, P. J. Bullivant, B. S. Bullivant, and A. W. Bullivant (all permanent). No qualification required. No other directors may be appointed without the consent of Bullivant & Co., Ltd., who have also power of veto in certain other matters (sale of forfeited shares and increase of capital). Solicitor: S. G. Spreat, 55, Queen Victoria Street, E.C. Registered office: 72, Mark Lane, E.C.

Electric Tools & Motors, Ltd. (157,867).—Private company. Registered August 12th. Capital, £16,000 in 10,000 pref. shares of 2s. each and 15,000 ordinary shares of £1 each. Objects: to carry on the business indicated by the title, and that of civil, mechanical, and electrical engineers, and to enter into an agreement with the Rt. Hon. Lord Clifford. The preference shares carry the right to a fixed cumulative preferential dividend of 50 per cent. per annum, and to participate with the ordinary shares in the surplus profits of each year, the preference shares taking two-fifths and the ordinary shares three-fifths. In a winding up, the preference shares rank in priority to the ordinary for return of capital, and participate *pari passu* with the ordinary in any surplus after paying off the entire paid-up capital. The subscribers (each with one share) are: H. Walker, 65, Madeley Road, Ealing, W., engineer. Lord Clifford is the first managing director. Solicitor: G. B. Ellis, 70-73, Chancery Lane, W.C. Registered office: 31-33, High Holborn, W.C. 2.

Luna, Ltd. (157,873).—Private company. Registered, August 12th. Capital £3,000 in £1 shares. Objects: to carry on the business of manufacturers and sellers of luminous and other signs, guides, devices, and novelties, &c. The subscribers (each with 100 shares) are: S. G. Catt, 327, Green Lanes, Finsbury Park, N., sales manager; E. S. Barralet, 1, Addison Road, W. 4, technical expert. The first directors are: S. G. Catt and E. S. Barralet. Qualification, 100 shares. Registered office: 3, Great Winchester Street, E.C.

Norman Johnson & Co., Ltd. (157,877).—Private company. Registered August 12th. Capital, £5,000 in £1 shares (2,500 6 per cent. pref.). Objects: to take over the business carried on by N. Johnson & Co., as engineers, and to carry on the business of electrical and general engineers and founders, manufacturers of motors, motor parts, and motor and aeroplane accessories, &c. Agreement with N. Johnson and E. J. Hawkins. The subscribers (each with one share) are: N. Johnson, 20, Stirling Road, Enfield, N., engineer; E. J. Hawkins, 149, Stapleton Hall Road, Stroud Green, N., electrical engineer. The first directors are: N. Johnson and E. J. Hawkins (both permanent, subject to each holding 500 ordinary shares). Registered office: "Hop Poles" Engineering Works, Baker Street, Enfield.

Timmins & Rogers, Ltd. (157,353).—Private company. Registered July 24th. Capital, £2,000 in £1 shares. Objects: to carry on the business of cabinet makers, joiners, upholsterers, French polishers, wood turners, furniture and musical instrument makers and dealers, drapers, electrical engineers, &c. The subscribers (each with 100 shares) are: H. Rogers, Feathers Hotel, Warrington, electrical engineer; A. A. Timmins, 91, Padgate Lane, Warrington, cabinet maker; G. H. Rogers, 34, Castle Street, Liverpool, claims assessor. The subscribers are to appoint the first directors. Secretary: G. H. Rogers. Registered office: St. Austin's Lane, Warrington.

Motor Distributors, Ltd. (157,875).—Private company. Registered August 12th. Capital, £500 in £1 shares. To carry on the business of manufacturers of and dealers in vehicles of all kinds, whether propelled by electricity, steam, gas, oil, or otherwise, auctioneers, motor, cycle, and general agents, proprietors of a motor exchange and mart, &c. The subscribers (each with one share) are: L. G. Greig, 66, Finsbury Pavement House, E.C., general merchant; J. I. Shirley, 66, Finsbury Pavement House, E.C., engineer. The first directors are: L. G. Greig and J. I. Shirly. Registered office: 66, Finsbury Pavement House, E.C.

Peerless Flash Lamp Co., Ltd. (157,854).—Private company. Registered August 11th. Capital, £34,000 in £1 shares. To enter into an agreement between the British Thomson-Houston Co., Ltd., of the one part, and James Y. Fletcher, of the General Electric Co., Ltd.; Sydney H. Callow, of Siemens Bros. & Co., Ltd., and Francis W. Willcox, of the British Thomson-Houston Co., Ltd. (on behalf of this company), of the other part, and to carry on the business of electric flash-lamp manufacturers, manufacturers of electric lamps of all kinds, aeronautical and general engineers, &c. The shares are to be issued in equal proportions to the British Thomson-Houston Co., Ltd., the General Electric Co., Ltd., and Siemens Bros. & Co., Ltd. The subscribers (each with one share) are F. W. Willcox, 77, Upper Thames Street, E.C. 4, electrical engineer and manager; J. Y. Fletcher, 67, Queen Victoria Street, E.C. 4, electrical engineer; S. H. Callow, 38-39, Upper Thames Street, E.C. 4, electrical engineer. The first directors are: F. W. W. Wilcox, of the British Thomson-Houston Co., Ltd.; J. Y. Fletcher, of the General Electric Co., Ltd.; and S. H. Callow, of Siemens Bros. & Co., Ltd. Solicitor: A. R. Monks, 123, Cannon Street, E.C. Registered office, 16 and 16a, Stonehouse Street, Clapham, S.W

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Ilfracombe Electric Light & Power Co., Ltd. (71,379).—Capital, £15,000 in £5 shares. Return dated May 26th, 1916. 77 shares taken up. £385 paid. Mortgages and charges, nil.

A. Hirst & Son, Ltd. (57,889).—Capital, £5,000 in 100 pref. and 400 ord. shares of £10 each. Return dated June 14th, 1919. All shares taken up. £2,000 paid on 100 pref. and 100 ord. £3,000 considered as paid on 300 ord. Mortgages and charges, nil.

Kidderminster & District Electric Lighting & Traction Co., Ltd. (59,972).—Capital, £100,000 in 5,000 pref. and 5,000 ord. shares of £10 each. Return dated June 10th, 1918. £3,000 pref. and 4,700 ord. shares taken up. £77,000 paid. Mortgages and charges, £42,500.

CITY NOTES.

Direct United States Cable Co., Ltd.

The annual meeting was held on August 12th at Winchester House, E.C. Sir James Pender, Bt., who presided, said that the accounts had been deferred until the whole of the expenses in connection with the abortive expedition of the cable steamer *Faraday* to repair the main cable in 1918 had been ascertained. The cost of maintaining the cables during the year under review amounted to £89,171, of which sum £77,028 represented the cost of the *Faraday* expedition. The total rental payable by the Western Union Telegraph Co. under the lease, including the contribution towards directors' fees, was £69,268, and in respect of that sum the Western Union had only paid during the year ended March 31st last £43,621, leaving a deficit of £16,646. In addition to that the Western Union were under the lease responsible for a portion of the administrative expenses of the company amounting to £886 which they had failed to remit. Those two items made a total of £17,533, which in whole or in part would come to them if their action against the Western Union was successful. He did not know that it was necessary to enter at length into a statement of the cause of difference between the two companies, as they had already given the shareholders full information. The control of the cable-repairing ships during the war was in the hands of the Admiralty, and they were unable to secure the services of any ship until the Admiralty allocated the *Faraday* to the company after she had completed certain work for the Western Union. They did not get the use of the ship until the summer of 1918 was well advanced. Unfortunately she was unable, before her machinery broke down, to make any effective attempt to repair the main cable in deep water where the interruption occurred. The expense of that expedition amounted to over £77,000, which appeared to the directors to be good evidence of their desire to conform to the terms of the lease, which required the cable to be repaired with the utmost possible dispatch. The circumstances that had occurred in connection with the expedition were not entirely unanticipated, and when he last addressed them he warned them that there might be delay in effecting the repairs, owing to the needs of the Admiralty. It was because they had done everything possible to effect the repairs, and were only prevented because the first use of the only vessel available was given to the Western Union, notwithstanding that they had first applied for her use, that they were surprised at the action of the Western Union in putting into force the penal clauses of the contract. The matter was now before the Courts, and they were doing everything possible to expedite the hearing of the action. The main cable was successfully repaired by the *Faraday* on June 28th last, and it was now in good working order, and was being operated by the Western Union. The shareholders must anticipate further heavy charges when the year's accounts were presented, in connection with the last successful expedition, as it was found necessary to insert a length of 230 knots of new cable during the repair. Fortunately the cable was purchased by the directors at a very low figure. The length inserted cost £31,243, and had it not been in stock its manufacture would have cost £83,275 to-day. As regarded the financial position, it could not be disguised that the heavy expenses of the abortive expedition of the *Faraday* had encroached very heavily upon their reserve fund. On the other hand, their investments were slowly but surely recovering from the low values at which they had stood for some time, and they still possessed a stock of cable which at present prices was worth £110,000. He could only express the sympathy which the directors felt with the shareholders in the withholding of dividends, and the hope that they would soon be able to announce a satisfactory issue of the difficulties with which they were now faced.

Mr. C. E. GUNTHER seconded the motion.

In the course of a discussion, Mr. E. C. HUMPHREYS said it was a most unfortunate thing that the Western Union had not shown a greater spirit of conciliation with the directors in dealing with the repairing of the cable. He could remember that at the time the arrangement was made great objection was taken by many of the shareholders to the control of the cable going over to the Americans. Now owing to the attitude which the Western Union had taken up, he thought there was a very good opportunity to approach the Government to see whether they could clear themselves of the American control.

Mr. COWAN (the solicitor) said that the directors had done all they could to avoid litigation, and it was only when they had either to submit to the lease being determined or to go to law that they took the latter course. The Western Union had not made any arrangement whereby they were to work the cable, and the mere fact that they were working it was, in his opinion, a most material circumstance in favour of the Direct United States Co.

The CHAIRMAN remarked that with regard to the point raised by Mr. Humphrey, as the case was *sub judice* they could not at the present time do anything about approaching the Government. When the matter was finished they could decide what further action they would take.

The report was adopted.

Prospectus.—*Reliance Fuel Co., Ltd.*—The list was to close on Wednesday in an issue of 365,000 7½ per cent. cumulative participating preference shares of £1 each (free of income tax) in this company, which has been formed to carry on the manufacture of briquettes and smokeless fuel under "a special trade process in conjunction with machinery which has been designed for the purpose." The *Financial Times* on Monday severely criticised the scheme. The plant has yet to be erected, and will probably take six months to install.

Brompton & Kensington Electricity Supply Co., Ltd.—Interim dividend for the June half-year on the ordinary shares at rate of 7 per cent. per annum, less tax.

Tramways Light & Power Co., Ltd.—The "London Gazette" for August 15th contains notice of the registration of the order of the Court confirming the reduction of the capital from £700,000 to £616,000.

Stock Exchange Notice.—The Committee has ordered the undermentioned to be officially quoted:—

Marconi International Marine Communication Co., Ltd.—592,286 additional shares of £1 each, fully paid (Nos. 600,001 to 1,192,286).

Waste Heat and Gas Electrical Generating Stations, Ltd.—Interim dividend of 2½ per cent. has been declared for the half-year ended July 31st, less income tax.

Aster Engineering Co. (1913), Ltd.—Interim dividend at the rate of 10 per cent. per annum, free of tax, for the June half-year.

Electro-Bleach & By-Products, Ltd.—Interim dividend 3½ per cent., less tax, on the preference shares.

STOCKS AND SHARES.

Tuesday Evening.

Coming so hotly upon the heels of Mr. Austen Chamberlain's "Road to Ruin" speech, the plain speaking of Mr. Lloyd George on Monday night was regarded in the Stock Exchange as "rubbing it in" with a vengeance. Market circles are relieved rather than otherwise at the Government's straight talk. The policy of drift rarely commends itself to business men, and the financial world has been gravely disquieted for some time past at the general outlook, of which one of the worst factors has been the apparent indifference to the need for economy on the part of the official spending departments. It looks now, however, as if the Government may at last set the lead in the way of curtailing extravagances, and the Stock Exchange markets express a sentiment of mingled relief and hopefulness. Labour leaders, too, are beginning to re-assume authority, which is interpreted as an indication that the solid sanity of the great majority of working men has a chance of prevailing over the noisy irresponsibles who have been doing such national damage.

Therefore, a calmer, less apprehensive atmosphere in the shares of companies engaged in various branches of national commerce. Improvements in "reconstruction" quotations, engineering, iron and steel, building and coal. Revival of buying from the big provincial centres of shares in local companies. Simultaneously, and quite logically, declines in prices of such concerns as are suspected, with or without reason, of making money by profiteering processes. Stock Exchange markets are decidedly interesting to study just now, even in the purely academic sense, for the movements in prices reflect with unusual fidelity the views of the public upon the politics—domestic and economic—of the moment.

Illumination companies had little chance to profiteer at any time during the war, and, so far as electric supply undertakings are concerned, they have had more kicks than ha'pence since 1914. Arising out of the Premier's speech, curiosity is again vocal as to the Government's likely course of action over the Electricity Supply Bill. Share prices, however, remain weak. Various small declines have occurred, and the market continues inert, awaiting developments.

Investment is again inquiring for securities upon which dividends are paid free of tax. The 6 per cent. Income bonds of the Underground Electric Railways rose to 96¼, but reverted to 96. The £10 shares have hardened ⅛, to 3⅜. National Steam Cars advanced on the statement that the long-expected agreement had been reached with the London General Omnibus Company. The suggestion that the Central London Railway might do better if the company were to be dissociated from the Underground group does not appear to command much sympathy. It scarcely seems an appropriate time, this, to discuss proposals of such a nature.

Cable stocks have not yet responded to the demand for tax-free dividend stocks just noted. Indeed, the market for the cable issues is dullish in consequence of the aerial service which is on the point of being inaugurated as a commercial proposition between London and Paris. Safer though it be to prophesy after the event, the individual opinion may be ventured that, on the basis of all past experience, there is plenty of room for profitable working on all classes of lines—aerial, submarine and land. The American cable companies' stocks have risen a little, but this is due more to exchange movements than to any particular buying. At the same time, there is increased demand for British Treasury certificates that were issued against securities what time our Government embarked upon the "mobilisation" scheme early in the war. And this demand comes principally from New York financial houses.

Marconis have subsided into quietude again, and keeping pretty closely for some days to the vicinity of 5⅜, fell back to 5 9-16. Marconi Marines are somewhat neglected at 3¼. Americans and Canadians have been harder at 30s. 6d. and 16s. 6d. respectively, but withdrawal of D.O.R.A. restrictions upon imports of foreign securities has caused a reaction from the best prices touched.

In the foreign group, Mexicans are flat owing to the extraordinary action of President Carranza in refusing to recognise the British Chargé d'Affairs. Mexico Trams at 40 are 3 points down. The Argentine list is disposed to harden up a trifle in sympathy with Argentine Rails, which improved upon a local decision that the companies are not liable for rates and taxes. Brazilians are erratic. A sagging tendency in Tractions was arrested by a few purchases by Scottish buyers, who have an eye to the future, but after touching 62 the price fell back to 60. Canadian and United States Utilities have been less inactive than usual, and price movements are mostly in favour of holders. Shawinigan Water is 3 higher at 136¼.

British Westinghouse preference have had a brisk rise to 3. It is thought that the buying must be for control purposes. The ordinary are 2½. Callenders, Castner Kellners and India Rubber shares are all lower. Babcock & Wilcox fell to 3¼, but recovered to 3⅜. Siemens have gone back to 6⅜. Rubber shares show an unwonted degree of strength. Armstrongs, Vickers, and others in this group are distinctly better, thanks to the more optimistic views that prevail in regard to Labour.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1917.	Dividend 1918.	Price Aug. 19, 1919.	Rise or fall.	Yield p.c.
Home Electricity Companies					
Brompton Ordinary	10	8	6⅝	—	£6 10 8
Charing Cross Ordinary	4	4	2⅞xd	—	7 8 6
do. do. do. 4½ Pref.	4½	4½	3⅝xd	—	7 4 0
Chelsea	8	8	5¼	—	4 16 0
City of London	8	8	11⅛	—	7 4 8
do. do. 6 per cent. Pref.	6	6	9⅜	— ⅛	6 3 1
County of London	7	7	9¼	— ⅛	7 9 7
do. do. 6 per cent. Pref.	6	6	9⅛	— ½	6 3 1
Kensington Ordinary	7	6	6½	—	6 14 6
London Electric	Nil	Nil	1½	—	Nil
do. do. 6 per cent. Pref.	6	6	8⅝	— ⅛	6 6 8
Metropolitan	4	5	2½xd	—	9 1 10
do. 4½ per cent. Pref.	4½	4½	3⅝	—	7 1 3
St. James' and Pall Mall	9	12	6½	—	8 0 0
South London	5	5	2½	—	7 6 4
South Metropolitan Pref.	7	7	20*	—	6 16 7
Westminster Ordinary	9	8	5½xd	—	7 12 5
Telegraphs and Telephones.					
Anglo-Am. Tel. Pref.	6	6	91	—1	6 7 8
do. Def.	1½	33/8	22	— ½	7 12 8
Chile Telephone	8	8	62	—	5 18 6
Cuba Sub. Ord.	7	7	10⅜	—	*8 13 4
Eastern Extension	8	8	15½	— ¼	*5 5 0
Eastern Tel. Ord.	8	8	159½	—	*5 0 4
Globe Tel. and T. Ord.	7	8	15⅜	—	*5 5 10
do. do. Pref.	6	6	10⅜	—	5 16 8
Great Northern Tel.	22	22	28⅜	—	7 14 5
Indo-European	18	18	61½	—2	6 6 8
Marconi	20	25	5⅜	— ⅛	4 9 8
Oriental Telephone Ord.	15	10	21	—	4 9 0
United R. Plate Tel.	8	8	7⅝	—	*5 2 8
West India and Panama	1/8	1/8	1⅛	— ⅛	*4 15 3
Western Telegraph	8	8	16½	—	*4 18 9
Home Rails.					
Central London Ord. Assented	4	4	68⅜	—	5 6 0
Metropolitan	1	1½	24½	—	5 2 0
do. District	Nil	Nil	22⅛	—	Nil
Underground Electric Ordinary	Nil	Nil	8⅜	+ ⅜	Nil
do. do. "A"	Nil	Nil	9/-	—	Nil
do. do. Income	4	5	90	—	*5 4 3
Foreign Trams, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	5	—	6 0 0
Anglo-Arg. Trams. First Pref.	5½	Nil	3⅜	—	—
do. do. 2nd Pref.	—	—	2⅜	—	—
do. do. 5 Deb.	5	5	65	—	7 13 10
Brazil Tractions	—	—	60	—1½	—
Bombay Electric Pref.	6	6	12½	+ ⅛	4 18 0
British Columbia Elec. Rly. Pfce.	5	5	56½	—	8 17 0
do. do. Preferred	Nil	2½	47½	—	5 5 8
do. do. Deferred	Nil	Nil	42½	—	Nil
do. do. Deb.	4½	4½	67	—1	7 3 8
Mexico Trams 5 per cent. Bonds	Nil	Nil	57	—1½	Nil
do. 6 per cent. Bonds	Nil	Nil	45½	—	Nil
Mexican Light Common	Nil	Nil	35	—	Nil
do. Pref.	Nil	Nil	48½	—	Nil
do. 1st Bonds	Nil	Nil	68½	—	—
Manufacturing Companies.					
Babcock & Wilcox	15	15	3⅜	—	4 9 9
British Aluminium Ord.	10	10	1⅝	—	6 3 1
British Insulated Ord.	25	12½	2⅛	—	6 1 0
British Westinghouse Pref.	7½	8	3	+ ⅜	5 6 8
Callenders	25	25	9	— ⅜	6 19 0
do. 6½ Pref.	5	6½	3⅜	—	6 8 10
Castner-Kellner	25	20	2¾	— ½	8 0 0
Crompton Ord.	7	10	21/6	—	9 6 0
Edison-Swan, "A"	—	—	1½	—	6 0 0
do. do. 5 per cent. Deb.	4	5	75½	—	6 5 9
Electric Construction	10	10	1⅜	—	8 18 0
Gen. Elec. Pref.	6	6½	1	—	6 10 0
do. Ord.	10	10	3	—	*5 0 0
Henley	25	25	2½	—	6 8 0
do. 4½ Pref.	4½	4½	3⅜	—	6 0 0
India-Rubber	15	15	17	— ½	*6 17 8
Siemens Ord.	—	10	6⅜	— ⅛	*7 17 0
Telegraph Con	20	20	25	—	4 17 0

*Dividends paid free of Income Tax.

MINERAL AND GOODS TRAFFIC ELECTRICALLY OPERATED.

By THEODORE STEVENS, B.Met., E.M., M.Inst.C.E.

The growing importance of the electrical operation of goods traffic as a means of handling more trains over existing permanent way, due to some extent to higher speed, to the proved ability to handle traffic with fewer locomotives, to fewer hours spent in the repair shop, and to greater regularity in service, demands attention.

Comparisons between a British steam locomotive mineral railway and an American electrified mineral railway (the Butte, Anaconda, and Pacific Railroad) call attention to differences worth investigation. The selected British railway handles practically the same total tons in a year as the American. Its passenger traffic represents only 2½ per cent. of the total receipts; so that there are reasonable grounds for considering the two railways comparable.

Parallel columns economise words, and leave the reader to make mental comparisons:—

	British.	American.
Route length, miles	56 Double track	31·6 114 miles single track electrified.
Other lines worked	11	—
Total locomotives	170 steam	21 electric
Total capital	£5,656,000	£1,300,000
Gross revenue	£657,000	£307,000
Gross revenue % of capital ...	11·6 %	23·6 %
Net revenue	£274,000	£101,000
Net revenue %	4·8 %	7·8 %
Locomotive repairs	£43,200	£12,000
Locomotive running ...	£97,700	£38,450
Goods and mineral miles ...	1,985,000	800,000
Tons carried, 1913	5,611,000	6,000,000
Heaviest gradients	6 miles 1 % up; 9 miles 1·5 % down	6 miles 1·1 % up; 4·6 miles 2·2 % up.
Total conditional ton-miles...	314,000,000	400,000,000

It is not suggested that there are not reasons for differences, but, noting the difference in route length, the British railway has eight times the number of locomotives and 2½ times both locomotive running cost and train-miles to handle less revenue paying tons.

Leaving those two types of locomotives, we now consider two electrified American lines on different systems, and study one of those lines on the two systems.

The Chicago, Milwaukee, and St. Paul Railroad purchases three-phase current, transmits it to sub-stations, steps down, converts it to direct current, which is distributed, collected, and utilised in D.C. motors.

The Norfolk and Western Railroad generates single-phase current, steps it up, transmits it, steps it down, distributes, collects it; then it is changed on each locomotive to three-phase for use in three-phase motors.

The first effort to examine closely the relative advantages of different systems leads to the discovery that a mass of material is available, but not in a form for rapid assimilation.

Some years ago, when inter-urban passenger line electrification was developing on both direct-current and straight single-phase systems, several lines newly equipped on the latter system were converted to the former *before* they were handed over by the contractor. So far as the writer is aware, no explanation has ever been given of the reason for those *first* installations.

The fact was so extraordinary, and efforts to get at the reason by correspondence so ineffective, that a visit was paid in 1910 to each of the railways.* In no case was the individual still in charge who had been responsible *for accepting* the straight single-phase proposal. The successor in authority was not the one whose basis for decisions, and whose qualifications one wanted to form an opinion about. It will be remembered that figures were promptly published showing the reduced consumption of energy under the direct-current system when it had been substituted in place of the single-phase, but nothing has ever been said to satisfy that query as to what led to the initial waste on the system which was known to be, for the particular conditions, the more costly, and which was scrapped within a year.

As a rule, goods-train service costs are not published, so it is first necessary to assume a service, basing it on as full a knowledge as practicable of the results attained: next, to work out the input at the drawbars for that service, allowing for regeneration of power when there are other trains running that can utilise it. Up to this point there is no distinction between the two systems—*i.e.*, the horse-power-hours or kilowatt-hours will be identical at the drawbar.

Sufficient data are not available to decide on the average losses in a locomotive which collects single-phase and develops power in three-phase motors. In crediting it with 75 per cent. efficiency, we believe we are generous to it, as compared with 77 per cent. for the direct-current locomotive described in the *Proceedings* of the Institution of Civil Engineers.

Believing that no figures have been published of the losses in distribution on either of the systems under comparison, we have determined these for the service specified in Table VII on each system, and, without encumbering this article with those calculations, state the percentage we found in each, and relocate the sub-stations on each railroad as though it were operated on the other's system, for the purpose of as fair a comparison as can be made.

From sub-station to power house each item of plant necessary in both systems has been carefully examined and fully discussed by the American Institute of Electrical Engineers. We give precise references and apply the respective efficiencies to our problem, considering it unnecessary to repeat details which are available in the American I.E.E. *Transactions*.

The next step was to work out capital and running costs of the Norfolk and Western service on the D.C. system, using three-phase generation, three-phase transmission, unity power-factor sub-stations, with the distribution losses; we determined for the service in Table VII on the Chicago, Milwaukee, and St. Paul Railroad, but for grades and trains on the Norfolk and Western Railroad in that table.

The Chicago, Milwaukee, and St. Paul Railroad Co. has published the cost of electrification, and Mr. W. B. Potter, chief engineer to the contractors responsible for the work, allocated to each of five items—transmission, sub-stations, distribution, bonding, and electric rolling stock—the respective parts of the total cost. No similar segregation of the published cost of Norfolk and Western Railroad's electrification has appeared.

A trial of the same percentages as in the case of the C.M. & S.P.R. on the N. & W.R. cost, leads us to conclude they are inapplicable, and to adopt another experimental segregation from which the appropriate parts of the working costs are deduced.

Our final results show that Norfolk and Western Railroad electrification, *as we see it*, and as redesigned by us on the direct-current system as explained above, is practically equal in capital and 10 per cent. different in running costs.

Results in tabular form leave the reader to make mental comparisons much more readily than if comparisons are expressed in words.

A glance at statistics of these railways of about that date in "Statistics of Railways in U.S.A. for the year ended June 30th, 1914,"* will put these electrifications "into perspective":—

* During that visit to America, a day was spent in the repair shops of each of several railways that maintained satisfactory train services with straight single-phase, the purpose being to form a useful opinion of their repairs. The most remarkable piece of work in hand was the removal of a burnt-out step-down transformer from a locomotive. The roof and sides of the locomotive, put on after the equipment had been fixed in the locomotive, had been riveted up beyond hope of dismantling. There were no means provided for taking hold of the transformer, nor clearance above or at the sides for a rope around it as it passed through the doorway, no chance to get a lift or grip, no head-room to allow a small roller to be used. Such absence of foresight in design should be impossible, and would be, if reasonable care were exercised in selection of men.

* With acknowledgments to London School of Economics Library.

TABLE I.—Mileages and Capital.*

	C.M. & S.P.R.	N. & W.R.
Single track miles owned, 1914...	9,630	2,023
" " " operated, 1914	9,987	2,036
Total property investment ...	£125,000,000	£51,000,000
Electrification " ...	3,750,000	750,000
Electrified route miles ...	(1915) 113 / (1919) 650	30 / 42
Voltage collected	3.000	11,000
Current "	D.C.	1 phase
Motors	"	3 "

Superimposing their route lengths on our own map will quickly give a concrete idea of each. Suppose we start at Glasgow with the western end of the longer, its first electric section would reach as far as Manchester.

Steam operation remains on a further section about equal to the distance from Manchester *viâ* London, to Ashford.

Thence, electric working extends a distance equal to that from Ashford *viâ* Dover, Calais and Paris, as far as Troyes.

The second electrification is equal to the Channel Tunnel's proposed length, and has double track except in a 3,000-ft. tunnel :—

TABLE II.—Route Lengths.

Route length.	Comparing our map.	Miles. Total.	Miles. El'tric.	C.M. & S.P.	Miles.	N. & W.
0	Glasgow	0	0	Tacoma	—	—
217	Manchester	211	211	Othello	—	—
401	London	—	—	Steam	—	—
458	Ashford	437	0	Avery	—	—
502	Dover	—	—	—	0	Vivian
524 to 531	Calais	—	—	—	29	Bluefield
688	Paris	—	—	—	—	—
900	Troyes	878	441	Harlo'ton	—	—
To locate them with reference to the cities used in the name of the railways, these distances are added:		1,803	—	St. Paul (steam)	106	Roanoke (steam)
		2,132	—	Milwaukee (steam)	—	—
		2,216	—	Chicago (steam)	392	Norfolk (steam)
		—	652	—	—	—

TABLE III.—Gradients.

C.M. & S.P.R. Miles.	Average gradient per cent.	N. & W.R. Miles.	Average gradient per cent.	Channel tunnel proposed. Miles.	Gradient per cent.
	(*a*)		(*c*)		(*d*)
58	0·4	5·6	0·7	2	1·8
20	1·7	5·2	1·1	6	·6
64	— ·4 to ·7	3·8	1·6	6	— 0·1
10	1·6	0·6	1·1	1	0·4
20	— 2·2	2·9	— 1·5	9	— 0·2
41	0·4	7·8	0·2	5	— 1·1
	(*b*)				
24	1·4	2·8	1·2		
14	— 1·3	·8	— 0·8		
20	— 0·5				
200	0·3				
8	1·4				
22	— 1·7				
52	— 0·1				
50	0·7				
50	(?)				
—		—		—	
653		29·5		29	

(*a*) *Electric Railway Journal*, July 21st, 1917, page 93.
(*b*) *Proceedings* Inst.C.E., 1916, page 176, Vol. CCI.
(*c*) *Proceedings* Inst.C.E., 1916, page 195.
(*d*) Channel Tunnel Co., Ltd.'s Publications.—Reports by Sir Douglas Fox, 1907 and 1913.

No desire exists to favour any system of electrification. Incidentally, it may be noted that war conditions prevented the collection of more complete data at the time.

Obviously, the value of any estimate is in proportion to the amount of accurate data on which it is based. Relatively, most complete cost data have been published on direct-current railway electrification working, and least on straight single-phase working—due, it was suggested in the *Electrical Times*, September 26th, 1918, page 190, to disciplinary reticence of railway managements.*

Sufficient average trains to move the total C.M. & S.P. revenue loads give 5,300 goods train-miles per day of 1,660 British tons revenue load and 590 tons wagon-tare per 250-ton locomotives ; also 3,200 passenger train-miles over 650 route-miles of 1,000 British tons per train made up of a 268-ton locomotives and 10 cars of 73 tons each.†

The sub-station plant and distribution systems we find are able to deal with this traffic in a 12-hour day.‡

Not knowing the average distances goods are carried, "conditional ton-miles," assuming that every load runs the whole length of the electrified route, have been calculated.

This, for 4,000,000 tons of goods and minerals handled per year, gives during 300 days 13,000,000 conditional ton-miles per day. Neglecting weight of passengers, there are 3,200,000 passenger ton-miles per day.

With such average trains 12 passenger and 40 goods locomotives would be in service.

Current is purchased from water-power plant mostly at 100,000 volts, three-phase, 60 cycles, and, for its transmission along the railway to the 22 sub-stations, 5,700 supports, 4,000 tons of conductors, and 600 tons of earth wire are used.

In the 22 sub-stations 127,000 K.V.A. of step-down transformers supply 101,500 KW. of synchronous motor-generators. The average cost of a sub-station is £33,700.

From the sub-stations 3,400 tons of feeders, 2,600 tons of contact wires, 1,400 tons of steel cables carried on 16,000 supports, distribute current at 3,000 volts to the trains, and a quarter million bonds are used on the track. There are 59 locomotives.

Table IV segregates the total cost, which was published as $18,000,000, of the C.M. and S.P. electrification, into five parts, according to Mr. W. B. Potter's statement.§

Mr. W. B. Potter, 14*th April*, 1916.		*Mr. B. F. Wood*, 1910.	
Transmission	10 %	9 %	£50,000
Sub-stations	18 %	18 %	100,000
Distribution	28 %	24 %	130,000
Bonding	4 %	4 %	21,000
Electric rolling stock ...	40 %	45 %	244,000
	100 %	100 %	£545,000

* *Electric Railway Journal*, November 21st, 1914 ; February 12th and October 21st, 1916 ; April 14th, 1917, page 704 ; May 26th, 1917, page 972 ; "Dawn of Electric Era in Railroading," 1917," pp. 16-19. "Electrical Review," Vol. 82, February 8th, 1918, page 134.

* "It is much to be regretted that so few official figures have been published in connection with the working costs of electrified railways. Furthermore, the ways in which figures are given are often misleading, and render any comparison of various systems very nearly impossible."—(From "Modern Railway Working," Vol. VI, 1913, page 56. Chapter by Mr. Philip Dawson, M.Inst.C.E.)

"I, for one, will stand opposed to fatuous comparisons which accept all the promises of the one and deny the possibilities of the others.—(Mr. F. J. Sprague, to American Institute of Electrical Engineers, *Proceedings*, January, 1912, page 10.)

In the *Proceedings*, American Institute of Electrical Engineers, June 28th, 1911, and January, 1912, page 27, Mr. Murray stated that the religion of his paper was to preach the doctrine of universal use of single-phase current on trunk lines and roads, inclusive of terminal territory, as applies to freight and passenger operation. Mr. Dawson, commenting on that paper, said : "No one, I think, denies that for long-distance work single-phase is the only solution."

But the only long-distance electrification in the world to-day, 1919, is direct current. We have seen no attempt to prove the economy, either in capital or in operating expenses, of straight single-phase.

How near in 1919 are we to the price predicted in 1911 in "London to Brighton in Forty-five Minutes," December 8th, 1911, and American Institute of Electrical Engineers' *Proceedings*, February, 1912, page 162, that single-phase railways would be able to purchase energy at 0·4d. to 0·45d. per unit in England, and "this will be the total cost to the company if A.C. is used" ?

An earlier prediction in *The Times Engineering Supplement*, April 10th, 1907, that "in 10 years D.C. railways will employ 3,000 volts in extended use," by Mr. Hobart, proved true in eight years.

† In the last quarter of 1916 the goods train-miles were 186,000 for 855 trains over 226 route-miles, and the "ton-miles per train-mile" were 1,960.

‡ Mr. A. H. Armstrong, in *Proceedings*, American Institute of Electrical Engineers, November, 1913, page 2,122, confirms this.

§ *Proceedings*, American Institute of Electrical Engineers, April 14th, 1916. Discussion of Renshaw on 5,000-volt system. For a check on these percentages we have extracted the similar items from Mr. B. F. Wood's fully detailed costs of the West Jersey and Sea Shore Railway (8,000 KW., 69 m. transmission, 81 route miles, 8 sub-stations, 17,000 KW., 93 cars), page 1,381.

Proceedings, American Institute of Electrical Engineers, Vol. XXX, June 28th, 1911.

The weights are calculated for net route lengths, which gives results within our limits of accuracy.

The resulting transmission cost seems inadequate, as the copper (if it were £80 per British ton) absorbs nearly the total allowed for transmission, but the distribution figure may cover such deficiency.

TABLE IV.—C.M. & S.P. Costs.*

Unit prices.		Mr. Potter's percentages.	Total.
£580 per mile.	647 miles transmission. 110,000 v. 5,700 poles. 4,000 tons conductors. 600 tons steel conductors. Labour.	10%	£375,000
£30,700 each.	22 sub-stations. 127,000 K.V.A. transformers. 101,500 KW. synchronous motor generators, switchboards and accessories, buildings.	18%	£675,000
£1,050 per mile.	1,000 miles distribution. 3,400 tons feeders. 2,600 tons contact wires. 1,400 tons steel cables. 16,000 cedar poles, with accessories. Labour.	28%	£1,050,000
£150 per mile.	1,000 miles of track bonded, say, 250,000 bonds.	4%	£150,000
£25,300 each.	59 locomotives.	40%	£1,500,000
	Total ...	100%	£3,750,000

Similarly, figuring average quantities to handle the mineral traffic on the N. & W.R., as no details "of the ordinary tonnage of the road" were obtained when these comparisons were made :—

Twelve electric locos., ten normally in service.	British ton-miles per day. Goods and minerals.	Passengers.
October, 1917 ...	1,300,000	14,300
December, 1917 ...	1,250,000	12,500
February, 1918 ...	1,560,000	12,800

On May 4th, 1914, 19 trains averaged 2,900 tons of coal eastbound from Elkhorn.

April, 1918.	Average per train.
30 days, 612 trains east, 25,865 wagons loaded ...	42
467 trains west, 26,157 wagons empty, 2,811 wagons loaded	62
Maximum in a day, 24 trains east, 1,056 wagons loaded	44
Minimum in a day, 10 trains east, 364 wagons loaded	36

We note there were 3,103 more wagons westward than eastward.

Twenty mineral trains per day carry, on the average, 2,200 tons revenue load in one direction per 480 tons of locomotives and 720 tons wagon tare.

Again, if the whole were drawn over the 29·5 route-miles, the "conditional ton-miles" per day would be 2,700,000 ; requiring 14 locomotives in service, all trains being average size.

Current is generated from coal in a steam plant of three 10,000-K.V.A., 11,000-volt, 25-cycle, one-phase turbo-alternators, stepped up to 44,000 volts, and transmitted to five sub-stations through 230 British tons of conductors and 55 tons of earth wire on 320 towers.

In these five sub-stations no rotating machinery is needed, the voltage is reduced to 11,000 in 28,000-K.V.A. static transformers, and distributed over 210 tons of copper and 170 tons of steel, carried on 1,750 standards. About 24,000 bonds are used in the track. Current at 11,000 volts is collected, and, by means of Alexanderson's transformer phase-splitter on each locomotive, three-phase current is supplied to the traction motors.†

(To be continued.)

* Mr. George Gibb, at New York Railroad Club, March 20th, 1914, said :—"The maximum (steam) eastbound tonnage at present is about 65,000 (U.S.) tons per day up the gradient, of which about 48,000 tons is revenue traffic ; this traffic is *exclusive of the ordinary* tonnage of the road."

Electric Railway Journal, page 323, August 24th, 1918.

† *Proceedings*, American Inst. of Elec. Eng., January, 1912, page 2.

SCIENCE AND ITS APPLICATION TO MARINE PROBLEMS.

Prof. J. C. McLellan, O.B.E., F.R.S., scientific adviser to the Admiralty, read a paper on the above subject before the North-East Coast Institution of Engineers and Shipbuilders at Newcastle-upon-Tyne, on July 10th last. We give below an abstract of the paper :—

For several reasons it is not possible to give details of a number of the measures taken and means of destruction adopted in the anti-submarine campaign, but in the following paper a brief survey will be given of some of the most notable advances made in dealing with certain naval and marine problems during the war.

Listening Devices.—Great improvements were made in hydrophones, microphones, and magnetophones of exceedingly high sensitivity were realised; means were devised for standardising their construction and functioning. Hydrophones were constructed and put into service which were suitable for use in water of moderate depth, and other types were made for use in water of great depth. In one type of instrument modifications were introduced which enabled one to detect with it the direction of bearing of a source of sound with a fair degree of accuracy. The best method of determining the direction of a source of sound waves in water is founded on the fact that the sound wave is in the same phase at all points of its wavefront. Thus two hydrophones, in themselves non-directional, placed in the path of the incoming sound can be used for finding the direction of the origin of the sound if the phase difference between the sounds received can be detected. There are two ways of doing this: the "binaural" method depends on the fact that if the sound from one receiver is conveyed to one ear and that from the second to the other ear, the impression is formed that the sound comes from a certain direction, and this direction as interpreted by the sensations experienced, changes as the phase difference is altered. It can be brought to a certain position with respect to the listener (say to the position directly in front) either by rotating the two receivers about an axis, or by introducing an artificial delay in some form of "compensator." This method has been the subject of much work on the part of both British and American scientists, and in the anti-submarine campaign it was found to be of very considerable service.

In the "sum and difference" method the impulses from the two receivers are united before reaching the ear, the combined effect observed being a maximum when there is no phase difference between the waves and a minimum when the phases are in opposition.

The French Navy has developed a hydrophone, known as the Walser gear, in which two sets of a number of sound receiving plates or studs are mounted on two areas which are convex to the sea, one on each side of the keel, on the underside of the hunting ship's hull. By this gear the sound impulses which they receive are not transmitted by tubes, but are given freely to the air inside the ship. These sound impulses are concentrated in a focus whose position in space depends on the direction from which the sound comes. The position of the sound focus is determined by means of a funnel or trumpet, from the contracted end of which a flexible tube leads to the listener's ear. The great advantage possessed by the Walser gear is that it enables one to distinguish by differences in the positions of the sound foci between sounds coming from a distant source and those generated in the water which have no specific directional feature characterising them. The gear can therefore be used by chasing ships when moving with fair speeds.

With most hydrophones ship's and water noises generally seriously interfered with their effective use. This defect was overcome in a measure by towing a directional hydrophone encased in an artificial "fish" behind a chasing ship. The development of sensitive listening devices received a great impetus by the use of thermionic amplifying valves. Even now the range of hearing is not more than 100 yards in the case of modern submarines moving at 2 or 3 knots.

Echo Methods.—A system of detection which is full of promise involves the use of a beam of sound waves sent out by a chasing ship in a manner analogous to the use of a searchlight. When an object of sound comes within the beam, the sound waves are reflected and echo effects are obtainable. The character of the beam is determined in large measure by the frequency of the waves constituting it. The method has been employed with great success.

Magnetic and Electro-magnetic Detection.—Magnetic detectors usually require the movable system to be poised or pivoted. They can therefore be used as yet with only a moderate degree of satisfaction in vessels subjected to violent mechanical disturbances. The range at which magnetic effects can be detected is, moreover, comparatively short. As a result of these defects the use of magnetic detection is somewhat circumscribed. Such instruments can, however, be used under certain conditions, and in particular sea areas with great effect. In the war very considerable results were actually obtained by their use. The range at which electro-magnetic detection can be applied is greater than is possible with magnetic detection, but the method is, however, essentially a short range one, and in many of the forms in which it has been worked out it cannot be used with success at

distances greater than about 300 yards or in depths greater than about 100 fathoms.

Leader Gear.—An important application of an electro-magnetic effect which was developed during the war is found in what is known as Leader gear, which consists of a cable laid on the bottom of the sea along the course of a narrow tortuous channel leading into a harbour or through a mine-field. If an alternating electric current be passed through such a cable it is possible by means of delicate devices installed on a ship to obtain either aural or visual indications of the presence of such a cable, and by these indications the ship can be guided in safety in fog or darkness at speeds as high as 20 knots. It is a simple matter to apply this method in water of suitable depth for distances as great as 50 miles or longer.

Invisible Signalling.—Research has shown that it is possible under certain conditions to utilise polarised light or ultra-violet and infra-red radiations for secret signalling. With the last-mentioned type of radiation especially valuable results are obtaineable over considerable distances, even in the presence of light fogs. Where it is not advisable to use wireless communication between chasing ships, infra-red signalling is of special value.

Wireless Telegraphy and Telephony.—By the use of oscillating thermionic valves especially great progress has been made in wireless telegraphy and telephony. It is now possible to hold conversation with ease between a land station or a ship and an airship or seaplane over considerable distances. With high-power installations wireless telephonic communication can be maintained on the sea over hundreds of miles. On the directional side of wireless great advances have also been made. The direction of the source of ether waves can be ascertained, and in a minute or two a land station can give the observer of the emitting source his bearing within two degrees relative to the land station. With two land stations it is possible to obtain cross bearings, and the latitude and longitude of the sending air or surface ship can be determined with a high degree of accuracy. Directional wireless will find a wide field of usefulness in connection with navigation.

Explosion pressures.—A most elaborate investigation of the characteristics of explosion pressure waves has been carried out for the Admiralty by Mr. H. W. Hilliar. By this method the pressure is allowed to act on a series of pistons and their velocity measured after they have travelled different distances. The velocity is found from the extent of crushing of a copper plug which the piston strikes when it comes to the end of its travel.

Another method of investigating such pressures, which was suggested by Sir J. J. Thomson and applied by Mr. D. A. Keys, consists in the employment of the phenomenon that certain crystals become charged with electricity when subjected to pressure. The amount of the charge produced is proportional to the pressure applied to the crystals, so by having a suitable arrangement for measuring this charge and its variation with time, a complete record of the variation of pressure with time is obtained by placing the crystal detector at any given distance from the exploding charge. My making use of the inertia of a beam of cathode-ray particles and employing the fact that they carry negative charges and are deflected by electrostatic and magnetic fields, records have been obtained of the variation of such pressures with the time. The electrons affect a photographic plate, which fact has made it possible to determine the change in pressure of the wave from the instant the charge is fired and at as small intervals as desired afterwards. Changes which take place in 1/100,000 of a second have been recorded by this means.

Sound Ranging.—In the course of investigations of the characteristics of pressure waves generated by the explosion of charges in the sea, it was found that when a hydrophone was used to pick up the waves a good record could be obtained by the explosion of a detonator at least two miles away. The explosions due to charges of 2 lb. of T.N.T. have been recorded at 14 miles, and might have been recorded at far greater distances judging from the strength of the signals received. The explosions of 300 lb. depth charges have been recorded up to 200 miles, and it is probable that with charges of moderate amount explosions occurring as far away as 500 miles can be readily recorded. Based on these results a system of sound ranging under water was developed. Four hydrophones were laid out 5 miles apart along a base line in deep water a mile or two from the shore, and in addition two pilot hydrophones were placed along a line at right angle to the base line, the one 5 miles out and the other at twice that distance. Cables were laid from the hydrophones to a recording instrument situated in a shore station. Four of these stations were installed at different places along the east coast of the British Isles, and other stations are now in progress of installation. With such sound ranging systems the shock of distant explosions occurring under water affects the various hydrophones in turn, and as time intervals can be read to 2 or 3 thousandths of a second with the apparatus now in use, it is possible to measure with accuracy the time intervals between the times of arrival of a sound wave at the different hydrophones, and so deduce the position of the explosion. Up to 50 miles the location of an explosion under water can be determined to within a few hundred yards by a single station, but for accuracy the co-operation of two stations would be necessary to locate explosions at greater distances. Within operable ranges a ship can be given its position by sound ranging more accurately than by directional wireless, or by any other known method. In the war it was a common thing for a monitor to proceed in a fog to a position some miles from the Belgian coast, and by dropping depth charges, have its position accurately determined from stations on the coast of England. So accurately was this done that when the monitor's guns were trained in selected directions objectives several miles inland could be hit with regularity.

Helium.—The first attempt to give practical effect to the development of supplies of helium for airship purposes was initiated by Sir Richard Threlfall, who received strong support from the Admiralty through the Board of Invention and Research.

In the course of investigations carried out with the co-operation of L'Air Liquide Co., it was found that large supplies of helium were available in Canada, which could be produced at a cost of about 1s. a cubic foot. In the spring of 1917 proposals were made to the Navy and Air Board and to the National Research Council of the U.S.A. to co-operate by developing the supplies of helium available in the United States. Large orders were placed by them with the Air Reduction Co. and the Linde Co. for plant, equipment, &c. The Bureau of Mines also co-operated by taking steps to develop a new type of rectifying and purifying machine. By July, 1918, the production of helium in moderate quantities was accomplished.

Experimental investigations were also initiated with the object of developing all possible technical and scientific uses of helium. In particular, balance, spectroscopic and electrical methods of testing the purity of the gas were worked out, and experiments were begun to exploit the use of helium in gas-filled incandescent lamps; gas-filled arc lamps, and in thermionic amplifying valves. The advances actually made at the time the armistice was signed warrants the opinion that by the present time, had the work projected been completed, supplies of helium at the rate of 2,000,000 cu. ft. a month would have been produced within the Empire and the United States at a low cost, and great progress would have been made in exploiting the technical and scientific uses of this gas.

Conclusion.—Under peace conditions many important technical systems and devices brought forward during the war will find immediate application as aids to navigation.

By means of directional wireless systems, ships or aircraft can be given their positions in fogs or unfavourable weather. By means of sound ranging it is possible to fix the positions of light-vessels, buoys, &c., and ships steaming in fog can be given their positions with accuracy for ranges up to as much as 500 miles. Aircraft in distress can call for help and be located when wireless gear becomes inoperable by simply dropping depth charges.

In hydrographic work generally sound ranging will be of the greatest service for surveys, and investigations can be carried out in fogs as well as in fair weather. The positions of the localities being investigated can always be determined in a few minutes when once a sound ranging station has been established on some shore within reach. By Leader gear in and out lanes of traffic can be organised and maintained with ease in fogs. The Echo methods can be used for sounding, for locating icebergs, vessels, and coasts in a fog. Helium can be utilised for the production of illuminating agents and for providing a means of investigating the fundamental properties of matter at the lowest temperatures attainable by man. Developments in internal combustion engines, in electric drive, and in the fuel values of new materials which were to be corporated in the Navy, will be of enormous value to the mercantile marine in the future. Advances made in wireless telegraphy and telephony and in secret signalling by specific types of radiation for war purposes will also prove of great service under peace conditions by providing novel, efficient, and less costly methods of communication.

With a view to developing and extending the scientific results which were obtained under stress of war, the Admiralty has recently put forward proposals for the permanent establishment of a Department of Research and Experiment within the Navy. The initial expenditure will be large, but it seems evident that an ample financial return will in a short time be obtained for the nation from profits accruing from a lowering of the rates of insurance and from a reduction in the cost of transportation.

Japanese Electrical Industry.—At the present time, says the *Financier and Bullionist*, there are in Japan 700 central stations, 530 power and electric light works, 42 electric tramways, 48 combined railway and lighting systems, 1,609 private electricity works and 53 Government works. In 1915 over 3,050,000 families used electric light; a year ago there were 152,000 telephone subscribers. It is certain that Japanese production of apparatus and machinery is unable to satisfy the requirements of the home markets, and the imports of articles of this nature during the last few years have been valued at £800,000 per annum. The Japanese engineering industry, in spite of high prices and the shortage of raw material, has made great progress during the war. The manufacturers have orders in hand until the end of June. The armistice terminated certain contracts, and owners of works are waiting to see the course of events. They are reconciled to a prospect of lower prices, but do not anticipate that they will have to close down.

ELECTRICITY SUPPLY DURING THE WAR.

By A. B. GRIDLEY and A. H. HUMAN.

(*From the Journal of the* Institution of Electrical Engineers. *Abstract.*)

This paper is intended to show what has been done, primarily by the public electricity supply undertakings, both municipal and company, and by the electrical manufacturing firms, and secondarily to explain the war policy of some of the Government departments associated with the direction of the industry.

The war had not been many weeks in progress before extensions of existing engineering factories and workshops and the construction of new factories, many of them national, were rapidly planned and carried out. The directing heads of many firms were called in to advise Government departments, in particular the Ministry of Munitions, and to take responsible posts, often without remuneration, in creating, organising, and accelerating the manufacture of every kind of war munition. The equipment of many new factories and the extension or adaptation of existing workshops were carried out at amazing speed. This was facilitated by the fact that so many of the public service electrical undertakings were able to deal with additional load by running all their generating plant, including reserve, until such time as the stations could be extended. In numerous cases valuable time was thus saved. Electrical equipments in factories could be installed much more rapidly than power-producing plant could be manufactured and erected, and although electric supply undertakings took risks in running all their generating plant, it was felt by the Government that this was a legitimate war risk, even if the supply of current for domestic purposes was thereby jeopardised.

As time went on it became a never-ending struggle to extend the public generating stations in industrial areas rapidly enough to meet the insistent demand for larger supplies of electrical power. Shortage of labour and materials made it essential that the output from the works of electrical manufacturing firms should be brought under Government control, so as to secure that only such orders should be proceeded with as were necessary to meet urgent national needs. Similarly, the extensions of electric power stations and mains systems were restricted to schemes authorised by the issue of priority certificates after applications had been investigated and approved by the Electric Power Supply Department of the Ministry of Munitions.

In some areas as, for example, the great steel and armament centre of Sheffield, and the busy machine-tool and motor-engine building district of Coventry, both Corporations were overwhelmed with pressing demands for large supplies of power. Large extensions of generating-plant capacity were rushed forward and proceeded day and night. While it may be thought invidious to mention these two electrical undertakings in particular, it must be remembered that their war expansion has been phenomenal. The following figures are indicative of this:—

	Sheffield.	Coventry.
Units sold 1914	26,500,000	17,000,000
,, 1918	177,500,000	53,000,000

It is also a fact to be noted that, in addition to the Sheffield Corporation's generating stations, some of the large armament firms have their own power houses, and the aggregate output of these private generating plants almost exactly equalled the Corporation's output. The 1918 production of electricity in Sheffield alone was about 350,000,000 units. No other industrial area—Sheffield covers about 38 sq. miles only—can show so large a consumption of electricity per sq. mile.

The great feature of Sheffield's electrical expansion was the installation by the steel manufacturers of electric furnaces. For various reasons the electric furnace prior to the war had made little headway in this country as compared with Germany and the United States. There are now, however, about 117 furnaces installed, or being erected, and of these no less than 74 are in the county of Yorkshire, by far the larger number in Sheffield itself. There can be no doubt that the makers of high-grade steels were faced with war problems which could only be solved by the extensive use of electric furnaces. Another undertaking which has shown remarkable expansion during the war is that of the Rotherham Corporation, which in 1914 had a generating-plant capacity aggregating only 5,180 kw. Since then it has been necessary to install a further 65,350 kw., one consumer alone, Messrs. Steel Peech & Tozer, requiring 10,000 kw. for their new steel works. It was found desirable that the Corporation should erect a new power house, and a station designed to contain two 12,500-kw. sets and one 25,000-kw. set was pushed forward and is now approaching completion. When this station is in operation, it will contain the largest machines so far constructed and installed in any generating station in Great Britain. Arrangements have been made for linking up this station with the Blackburn Meadows generating station of the Sheffield Corporation, so that 10,000 kw. can be transmitted either way.

Of other undertakings which have carried out or ordered extensive plant additions during the war, the following are the more important:—

	(Installed or ordered) kw.
Newcastle-upon-Tyne E.S. Co. and associated companies	114,200
Glasgow	99,500
Sheffield	73,000
Birmingham	51,650
Manchester	46,450
Clyde Valley E.P. Co.	37,500
Leeds	33,660
Bradford	27,450
Mersey Power Co., Ltd.	24,500
North Met. E.P.S. Co.	21,068

A complete list of all power-station extensions arranged for during the war is given.* Other parts of the country in which abnormal expansion took place were as follows:—

Increase in Units Sold in 1918 as Compared with 1914.

	Increase.
Newcastle-upon-Tyne E.S. Co. and associated companies	203,547,122
Glasgow	90,250,000
Clyde Valley E.P. Co.	80,942,565
Birmingham	77,962,851
Manchester	74,953,067
Shrop., Worcester, and Staff. E.P. Co.	50,549,772
Leeds	34,800,732
Liverpool	27,967,346
Bradford	27,129,229
North Met. E.P.S. Co.	25,921,117
Wolverhampton	25,806,186
Rotherham	20,219,945
Greenock	18,749,536
Yorkshire E.P. Co.	18,673,871
Mid. Elec. Corp. for Power Distribution, Ltd.	16,982,773
South Met. E.L. & P. Co.	16,833,862
Mersey Power Co.	15,582,000
Stockport	14,892,745
Lancashire E.P. Co.	13,266,574
Derby	12,000,000
Bristol	10,702,527
S. Wales E.P. Distribution Co.	10,083,812

Apart from the great development in the use of electric furnaces, the next most interesting expansion was probably that of the use of electrically-driven compressors in shipyards. A large programme of compressor installations was put in hand in various shipbuilding centres, some 80 compressors being ordered, totalling in all approximately 33,000 h.p.

The wider use of electricity for welding ships' plates at an early date is anticipated, and also the use of electricity for cooking purposes has largely extended during the war. In the Newcastle district there is a cooking-load totalling about 4,000 kw.

During the early months of 1918 attention was drawn by a leading English electrical manufacturing concern to an improved form of electric regenerative dynamometer gear which could be used in testing aeroplane engines. An effort was made to have these sets introduced. Unfortunately it was found that some six months would elapse before the sets could be placed on the market, and the aeroplane makers at that time were in doubt as to the future policy of the Air Board. Further, one of the leading electric supply undertakings refused to sanction these regenerative sets being connected to its system. Negotiations ceased on the armistice being signed. Further work should undoubtedly be done to develop and introduce an electrical regenerator for all test-rooms. Take the following hypothetical case: Number of engines tested per week, 60; indicated h.p. of each engine, 250; average duration of each full-load brake test, 2.5 hours; number of regenerative dynamometers, 10; total capital cost of dynamometers, £15,000. On the assumption that the overall efficiency of the dynamometer is 50 per cent.: Total units produced per week = 60×250×0.5×2.5×0.746 = say, 14,000. On the basis of 1d. per unit this represents £58 per week as the value of the energy obtainable, or, say, £2,900 per year.

The following data give some idea of the great expansion in the generating plant capacity and output of public electric supply undertakings during the war. (Power stations supplying railways or tramways only, and private plant, are not included):—103 municipal and 33 company-owned power stations were extended or built. The plant capacity of 327 municipal undertakings increased from 705,000 kw. installed at June, 1914, to 1,490,000 kw. installed, or on order, at October 31st, 1918. Similarly, some 230 company-owned power stations expanded from 430,000 kw. to 788,000 kw. The additional

* This list was published in the Electrical Review of November 22nd, 1918.—Eds.

generating-plant capacity installed, or ordered, during the war therefore aggregated 1,143,000 KW., which is almost exactly equal to the total plant capacity existing when the war broke out.

The capital outlay involved on these extensions, with additions to mains and sub-stations, was approximately £23,000,000. Before the war the average size of generating unit installed was 522 KW., and the largest unit in operation was of 8,000 KW. capacity. The average size of unit on order at October 31st, 1918, was 7,044 KW., and units of 25,000 KW. and 30,000 KW. were being built. The units sold during the year ended June 30th, 1914, were 2,100 millions. For the year ended December 31st, 1917, they were 3,520 millions. It can be assumed that the output for 1918 was nearly double that of 1914. The coal consumption per unit sold in 1914 was 4.1 lb. In spite of the very inferior fuel used in 1918 in comparison with 1914, the coal consumption in 1918 fell to 3.75 lb. In 1918 the coal consumption in municipal stations was 4.17 lb. per unit, and in company stations 3.17 lb. In 1918 the load factor of all the municipal stations combined was 28 per cent., and of all the company stations 33 per cent. The load factor of individual stations varied widely. The units sold per KW. of plant installed were 1,658 by the municipalities and 1,882 by the companies. At December 31st, 1918, the municipalities had 237,000 KW. of load awaiting connection, and the companies 121,000 KW. The units obtained other than by coal-firing were : Oil fuel, 50,000,000; waste heat and gas, 215,000,000; water power, 23,000,000. About 27,000 persons were employed in electric supply undertakings, of whom about 2,500 were women. Some 17,000 were employed by the municipalities, and 10,000 by companies. The whole of the increased output during the war was used for power, smelting, and other industrial purposes. The war definitely established the pre-eminence of electricity as *the* motive power for industry. During the war a large number of manufacturers who had previously little or no experience of the electric drive have become fully acquainted with its advantages and have realised, in particular, the desirability of purchasing energy from public sources instead of generating it by separate power plant. This was the Government policy during the war. There were, however, considerable orders placed during the war for private electrical generating plant, particularly in connection with the many large extensions of iron and steel works. In most of these cases waste heat, in the form of exhaust steam from rolling-mill engines or gas from blast furnaces and coke-ovens, was to be used for electric power production, and private plant was therefore justified. Wherever possible, however, linking up with an adjacent public service electrical undertaking was arranged. At the end of 1918 the following turbo-generators were on order under Class A :—Municipalities, 228,000 KW.; public service companies, 163,000 KW.; private plant, 88,000 KW. The Treasury decided that interest-bearing loans might be made, where necessary, to municipalities and companies, the loans generally being repayable by annual instalments over 15 years or so, and further, that the Ministry of Munitions might guarantee to bear the difference between the cost of carrying out extensions during the war and the estimated cost of the same work if carried out at some period after the conclusion of hostilities—this period as a rule being one year or two years post-war—and also the cost of any portion of the extensions found to be in excess of the post-war needs of the undertaking. Of the £23,000,000 which it is estimated has been incurred on extensions of power houses and mains during the war, about £3,150,000 has been advanced by the Ministry of Munitions. The number of employés at work in Woolwich Arsenal increased five-fold during the war. The maximum power load reached about 8,000 KW. In 1914 the supply was mainly derived from the small generating station at the Arsenal, supplemented by a supply taken from the electricity undertaking of the Woolwich Borough Council. These two sources combined were insufficient to meet the war requirements, and extensions of the Woolwich B.C. generating station were accordingly put in hand. That undertaking was also linked up with the mains network of the South Met. E.L. and P. Co., so as to secure a standby supply from the latter. In addition, cables were laid linking up the Arsenal with the Greenwich power house of the L.C.C. tramways undertaking, which, unfortunately, was a 25-cycle system, whereas the periodicity of the Woolwich Council's undertaking was 50 cycles. The supply from the L.C.C. was utilised primarily for operating rotary converters (D.C. being mainly used at the Arsenal) and also for the supply to electric furnaces installed at the Arsenal for the production of steel from scrap material. The furnace transformers were provided with reactances, so that they could ultimately be operated at 50 cycles instead of 25 cycles if, after the war, the Woolwich B.C. electricity undertaking was in a position to deal with the whole load at the Arsenal.

As the result of experience gained in the field it is most probable that the requirements of the Army for electrical equipment will increase both in peace and in war. The standardisation of electrical machinery and closer co-operation between Government Departments is therefore more than ever of importance. The use of A.C. rather than D.C. should be encouraged even for use in the field, and any difficulties faced and surmounted. The experience of the American Forces has demonstrated that if large numbers of troops have to act in a country far distant from home, electric power requirements are likely to be very large and of first importance. The German forces found the establishment of an Electrical Battalion for each Army of vital importance, and military sites were carefully chosen after prior consideration had been given to their convenience from the point of view of electric power supply. Early this year a Commission was set up by G.H.Q., France, to investigate and report on the use of electric power in the field. Mr. C. H. Wordingham, president of the institution, was a valuable member of this Commission.

Only two Control Orders were issued by the Ministry of Munitions. The first, dated April 5th, 1918, restricted the manufacture of converting plant (Converter Plant Control Order, 1918). It had been found that some power users, and shipbuilding firms in particular, hesitated to use the more readily available supply of A.C. in certain districts, owing to their previous familiarity with D.C. only, and no amount of persuasion seemed to convince them that A.C. was equally, if not more, suitable. The enforcement of the Converter Plant Control Order did bring about a reduction in the demand for converting plant, and subsequent experience proved to power users that their previous fears were ill-founded. There nevertheless remains a considerable amount of missionary work to be done in this direction. At the conclusion of hostilities, in spite of the Control Order, there were no less than 92,000 KW. of converting plant capacity on order under Class "A" certificates, although by far the larger proportion of this was required for the production of D.C. for purposes where A.C. was unsuitable. The Converter Plant Control Order, 1918, was cancelled on February 28th, 1919, after 193 licences had been issued. The second Control Order was the Electricity (Restriction of New Supply) Order, 1918, issued on November 8th, 1918. Concurrently with it the Coal Controller found it necessary to ration the use both of electricity and of gas for domestic purposes. This Order was revoked on January 10th, 1919. After the formation of the Department of the Coal Controller, close touch was kept between that Department and the Electric Power Supply Department of the Ministry of Munitions. Wherever munition firms derived their motive power from inefficient steam plant wastefully consuming coal, every encouragement was given to such firms to take advantage of the public supplies of electricity. Unfortunately economy in this direction was limited by the difficulty of obtaining electrical equipments for factories. The Coal Controller's Department and the Coal Commission must have ample information concerning existing wasteful steam plant, and it would be a national misfortune if such data as has been collected is not turned to account as soon as possible, by taking action to ensure that such plant is speedily scrapped and the more efficient electrical equipment installed in lieu thereof. Of the total of 103 municipal and 34 company extensions, 70 of the municipal and 22 of the company schemes were considered and sanctioned by the Ministry of Munitions. The remainder were presumably put in hand before the priority system was established. The plant capacity involved was : 70 municipalities, 697,000 KW.; 22 companies, 330,000 KW. It is to the credit of the public service electric supply undertaings that the supply of electricity throughout the war was maintained in nearly every part of the country practically uninterruptedly. The record for reliability is a matter for both pride and satisfaction, especially when the abnormal difficulties referred to are remembered, and redounds to the credit of the responsible engineers and their staffs, and is a good augury for the confidence with which manufacturers can, when normal conditions return, rely upon the supply from public undertakings. There was not, as was the case with most manufacturing firms, the incentive of increased profits to be earned. The electric supply undertakings which paid excess profits during the war can be counted on the fingers of one hand. By far the larger number of them have had to raise their prices substantially to keep expenses below receipts. When all the circumstances are taken into account it is not easy to express adequately the value of the services rendered by electrical engineers. The four years of war saw practically a development of electrical output equivalent to that of the previous 32 years. They have well merited and earned the gratitude of the nation.

Part II. of the paper will be published later.

American Push—on the Cheap.—As practical business men the Americans have made a lot of money out of war contracts, and many of the manufacturing firms are incurring expenditure with the object of promoting trade in Holland and the Scandinavian countries. Schemes of this kind cost money, as those who are pushing iron and steel products in Holland have already found out. But what will be thought of the following, which is quoted from a Rotterdam newspaper of the date of August 19th :—"Technical salesman wanted capable of managing a branch office in Holland for an American firm exporting machine tools, electrical goods, agricultural equipment, and building specialities. Must pay own running expenses out of liberal gross commission. Only men with exceptional ability, good connections, and first-class references considered. Write giving references." If the American firm in question has made any money out of war business, it is obvious that there is no intention of parting with it, or applicants would not be asked to agree to "pay own running expenses" on a new branch business which has yet to "get in" the Dutch market.

ELECTRIC BATTERY LOCOMOTIVES.

During the past three years the Ministry of Munitions has made considerable use of small battery locmotives, some of which, supplied by the Brush Electrical Engineering Co., Ltd., Loughborough, were used on the narrow-gauge lines at the munition factories at Gretna (Carlisle), Queensferry, and at Avonmouth. This type of locomotive, illustrated in fig. 1, is provided with a platform and cab in the centre to accommodate the driver and the necessary control gear. The main framing of the vehicle consists of rolled mild steel and iron, forming a thoroughly rigid structure. No floor is provided for the battery compartments, but wood blocks are secured to the framing members to act as bearers for the battery boxes. The superstructure consists of a central portion for the driver and two end portions for the batteries. The roof of the driver's cab is of sheet steel, similar material being also used for enclosing the battery compartments. Hinged doors are provided on each side of each battery compartment, and the bonnet is also hinged, to facilitate the withdrawal and replacement of the batteries. Glazed windows in hinged wooden frames are provided at the front and rear of the driver's cab, and at the sides storm blinds are fitted, of the roller type and have each a small celluloid window. The locomotive is mounted on four flanged running wheels of cast steel, 14 in. on the tread and about 3 in. wide over the tread and the flange. They are mounted on axles turned from mild steel bar, and are arranged for running on narrow gauge tracks. The axles run in four heavy type ball bearings bolted to forged steel stretcher bars set down at the ends to form seatings for the bearing springs, which are of coiled steel, two at each side of the vehicle, and provided with guides passing through the centre of the springs. Simple spring draw and buffing gear is provided at each end for coupling up to the trailer vehicles. An angle steel re-railing fender with wood packing is fixed across each end, extending from the main frame to a position about 2 in. above rail level. This is for levering the vehicle back to the track in the event of derailment.

The battery is of the Chloride Electrical Storage Co.'s "Iron-clad Exide" type, consisting of 48 cells fitted into four containing trays to facilitate removal. This battery is

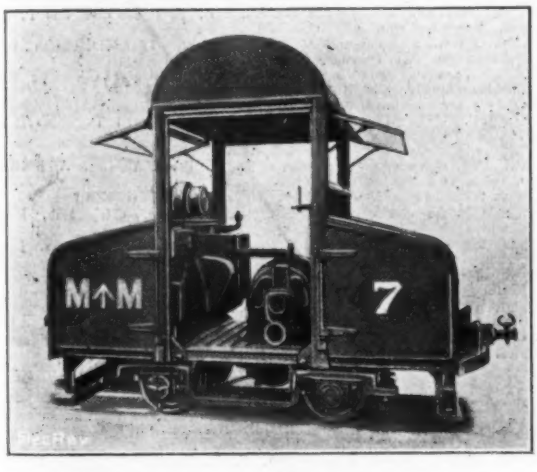

Fig. 1.—Narrow-gauge Battery Locomotive.

specially designed for traction purposes, and the rating is dependent upon the duty of the locomotive. The motor is of "Brush" standard design, wound for 80/100 volts D.C., and amply protected against rain and dirt. It is of the interpolar type, and the shaft runs in gunmetal bearings lubricated by oil rings.

The drive is through a mild steel countershaft by means of "silent" chains and chain wheels. The first drive is from the motor shaft to the countershaft which is carried across the frame and runs in two ball bearings. There are further chain drives from the countershaft to each axle. The drive from the motor shaft to the countershaft is protected by means of a sheet metal cover extending to the floor of the cab. The band brake is lined with "Ferodo," and acts on a cast-iron drum secured to the countershaft; it is operated by means of a handwheel attached to a spindle screwed at the lower end.

The controller is arranged to give three speeds in either direction; the first speed is for starting only, there being resistance in circuit with the motor. The second notch gives approximately half speed with full load torque, and the third notch gives full speed with full load torque. An iron-clad circuit breaker is fitted controlling the supply to the motor, and a charging plug of standard type is also provided.

The locomotive can be equipped within limits for duties specified, but if no particular duty is specified, a battery having a capacity of 150 amp. hours at the 5-hours discharge rate is supplied. With this battery the locomotive will haul 3 to 4 tons at about 5 miles per hour on the level, or at a somewhat reduced speed on slight gradients—making a total of 15 miles between charges, spread over an 8-hours day. If a mid-day boost of one hour's duration is given, the service may be increased to, say, 10 miles before and 10 miles after the boost, making 20 miles for the day, the battery being fully charged at night.

Fig. 1 shows the normal appearance of the standard narrow-gauge battery locomotive; it can be entirely enclosed as in-

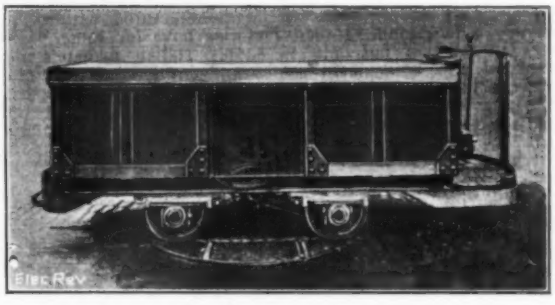

Fig. 2.—In-door Type of Battery Locomotive.

dicated above for protection against weather. Fig. 2 shows an in-door type of battery locomotive arranged to carry a portion of its load and to draw the remainder. Such locomotives are becoming more popular where intermittent shunting and miscellaneous haulage are essential, especially in works and factories. The absence of steam, smoke and the reduced fire risk are features of importance, while other advantages are availability for immediate use, they do not require constant attention when not in use, nor do they require skilled attention to look after and operate them.

THE ITALIAN MARKET FOR ELECTRICAL MATERIAL.

Italian production of electrical material is still insufficient to supply the increasing demand. How long this will continue it is difficult to say, because much new manufacture is in course of development. The position has recently been reviewed by the United States Consul in Florence, who states that Italy makes practically all the D.C. machines needed, as well as turbines up to 1,500 KW. A.C. machines have been made up to 15,000 KW., and a few machines up to 15,000 volts. Transformers have been made up to 12,000 KW., 90,000 volts. Central power station equipment is practically all manufactured in Italy. Italian shops have also turned out tramway stock and the powerful three-phase electric locomotives which haul the heavy trains on the Giovi, Monoenisio, and Valtellina lines. Five strong Italian concerns are at present producing, in a very satisfactory fashion, all electrical equipment needed. Until very recently many tramway cars, completely assembled, came from Belgium, because of the fact that control of certain tramways in Italy was in Belgium. An extensive development of interurban traffic might have been possible but for the progress made by autobus companies.

Electrical equipment for ship propulsion has not been developed, and if present plans for increasing the merchant marine are carried out there will be an excellent market for such machinery.

The manufacture of electric household appliances has developed greatly within the past few years. Many new plants have been established for their manufacture, and existing plants have been enlarged. Further increase in this market depends upon the price charged for electric current. Government taxes on current for any other than purely industrial purposes form a heavy proportion of the cost.

Electric pumps, ventialtors, searchlights, magnetos and sparking devices to be used in connection with internal-combustion engines, and electric installations on automobiles and motor trucks, are manufactured in Italy in sufficient quantities and varieties to satisfy all present requirements.

What are not manufactured in Italy are monophase motors or three-phase motors with collectors, induction motors with auto-exciters, and phase converters contained in a single machine. The Italian production of accumulators is sufficient to supply the local market. One half the demand for measuring instruments was supplied by the home factories, and the other half, before the war, came principally from Germany. At present the demand for the commoner types is supplied by Italian manufacturers, whereas the specialised type, such as vibrating frequency meters, synchronoscopes, phasemeters, and indicators, come from abroad. About a fourth of the 100,000 meters consumed annually in Italy before the war were manufactured within the country. Instruments of precision imported came almost entirely from

Germany and Switzerland, except for a very few from the United States. Switchboards for large, medium, and small installations for the production and distribution of electrical energy, as well as for its utilisation for lighting, heating, and power purposes, are made in sufficient quantities within the country. Special equipment, however, was always imported from Germany before the war.

It is impossible to give an idea of the extent and use of machinery and equipment for ships; mining, chemical, and explosive plants; or of appliances for automatic controls, block systems, and safety; but during the war successful types of ship installations have been made in Italy, and it is thought that all of these will be manufactured within the country before long. Italian factories have for some years been in position not only to supply Italian demands for insulated and uninsulated cables and insulated conductors, but also to manufacture for the export trade. The imports of copper cables made before the war were principally the result of the custom of foreign companies, especially German, requiring their branches or agencies doing business here to purchase supplies from them. Electric light bulbs came principally from Germany and Austria-Hungary before the war, but since that time Holland has supplied the market.

The future of imports into Italy of electrical machinery, supplies and equipment really depends upon whether this demand comes suddenly or develops gradually after the war. If it should be sudden, imports would be necessary in many articles, but if it should be gradual it would find Italian manufacturers in position to meet all requirements except for a few special articles. The trade with the United States, as far as imports are concerned, depends, in the main, upon credit terms, speedy shipments, and quality consistent with Italian standards.

NEW PATENTS APPLIED FOR, 1919.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

19,199. "Motor starters, rheostats, &c." L. K. Vier. August 5th.

19,215. "Mouthpiece for telephone instruments." J. Knight. August 5th.

19,219. "Terminal electric connections for sparking plugs." M. L. Williams. August 5th.

19,225. "Electric conductors." S. H. Lees. August 5th.

19,236. "Electric lighting systems." D. E. Westcott. August 5th.

19,250. "Fuse fittings." L. Stewart. August 5th.

19,251. "Telephonic transmission systems." Western Electric Co. (Western Electric Co.) August 5th.

19,260. "Electric heating devices." British Thomson-Houston Co. (General Electric Co.) August 5th.

19,284. "Magneto-electric machines." American Bosch Magneto Corporation. August 5th. (United States, September 27th, 1918.)

19,300. "Magneto-electric generators for internal-combustion engines." C. Godfrey. August 5th.

19,316. "Electro-deposited metals." C. P. Madsen. August 5th. (United States, April 26th.)

19,327. "Electric switches." J. B. Tucker. August 6th.

19,335. "Fitting for collection and use of low-tension current of high-tension magneto-electric machine for lighting, &c." I. A. J. Duff. August 6th.

19,353. "Electric plug connectors." W. Ile. August 6th.

19,356. "Negative and positive resistance vacuum tube devices for wireless telegraphy, &c." J. Scott-Taggart. August 6th.

19,358. "Sparking plugs." W. A. Jones. August 6th.

19,366. "Electric arc welding." F. J. Heyes. August 6th.

19,367. "Holder for arc welding." G. Uglow. August 6th.

19,377. "Electric switches." E. M. Hewlett. August 6th. (United States, October 31st, 1918.)

19,378. "Electric furnaces." E. F. Collins. August 6th. (United States, September 21st, 1918.)

19,383. "Material for manufacture of electrodes." O. R. Olsen. August 6th.

19,389. "Radio signalling apparatus." Marconi Wireless Telegraph Co. August 6th. (United States, February 7th.)

19,393. "Device for protecting windings against over pressures." Akt-Ges Brown, Boveri et Cie. August 6th. (Germany, August 6th, 1918.)

19,400. "Telephone exchange systems." G. Deakin and Western Electric Co. August 6th. (United States, May 26th.)

19,404. "Electric switches." M. Compare. August 6th.

19,418. "Sparking plugs." A. H. Cressy. August 6th.

19,424. "Printing apparatus for reproducing in ordinary printed characters telegraphic messages." F. G. Creed and Creed & Co. August 6th.

19,428. "Electro-deposition of iron alloy." S. O. Cowper-Coles. August 6th.

19,429. "Manufacture of iron tubes by elctro-deposition." S. O. Cowper-Coles. August 6th.

19,430. "Apparatus for electro-deposition of iron.' S. O. Cowper-Coles. August 6th.

19,431. "Process for recovery of iron from scrap tinned steel." S. O. Cowper-Coles. August 6th.

19,436. "Electric lighters or igniters." A. B. Seabourne. August 7th.

19,443. "Obtaining currents of two periodicities from one generating unit." H. A. L. Barry. August 7th.

19,453. "Electric hand torches, &c." E. W. Parsons. August 7th.

19,459. "Incandescent electric lamp sockets, &c." Benjamin Electric Ltd., E. Fowler and R. A. Ives. August 7th.

19,465. "Method of altering electrical conductivity of metals." F. H. Loring. August 7th.

19,479. "Modulating and transmitting systems for electric signalling." Western Electric Co. (Western Electric Co.) August 7th.

19,488. "Electric switches." W. Burkinshaw. August 7th.

19,493. "Magneto-electric pocket lamp." E. Jaquemot and M. A. Pattay. August 7th. (Switzerland, August 7th, 1918.)

19,497. "Means for regulating electric generators driven by air screws, &c." J. M. Furnival and H. R. C. van de Velde. August 7th.

19,498. "Thermionic devices for wireless telegraphy and telephony." H. J. Round. August 7th.

19,525. "Coin-freed and electro-magnetically freed apparatus for telephones." C. R. Wheeler. August 7th.

19,534. "Electric lighting systems for trains, &c." F. Browne. August 8th.

19,563. "Electric lamp holders." A. P. Rutherford. August 8th.

19,566. "Electric relays." A. Orling and Orling's Telegraph Instruments Syndicate. August 8th.

19,567. "Electrodes." E. E. Greville and R. W. Read. August 8th.

19,570. "Magneto-electric machines." British Thomson-Houston Co. and A. P. Young. August 8th.

19,571. "Induction electric furnaces." British Thomson-Houston Co. (General Electric Co.) August 8th.

19,578. "Contact making and breaking devices." S. Antliff. August 8th.

19,599. "Electrical apparatus for heating liquids." H. C. Sanders. August 8th.

19,605. "Electric transmission mechanism." D. B. Kinahan. August 8th.

19,613. "Tuned ionic oscillator." R. Whiddington. August 9th.

19,614. "Obtaining alternating currents of any frequency from existing three-phase systems of any other frequency." A. M. Taylor. August 9th.

19,632. "Electric motor for vacuum cleaners, &c." W. J. Axworthy and Magic Appliances, Ltd. August 9th.

19,636. "Electric heating units." British Thomson-Houston Co. (General Electric Co.). August 9th.

19,640. "Rotary quick break switch." J. W. Johnson. August 9th.

19,652. "Sparking plug." E. Goldsmit-Abrahams and W. S. Shepard. August 9th.

PUBLISHED SPECIFICATIONS.

The numbers in parenthesis are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1917.

13,094. Audion or lamp relays or amplifying apparatus. M. Latour. September 12th, 1916. (Addition to 5,363/17.) (129,659.)

14,165. Audion or lamp relays or amplifying apparatus. M. Latour. October 2nd, 1916. ((Addition to 5,363/17.) (129,660.)

15,543. Audion or lamp relays or amplifying apparatus. M. Latour. October 23rd, 1916. (Addition to 5,363/17.) (129,661.)

17,011. Electric signalling apparatus. F. S. S. Wates. November 17th, 1917. (129,665.)

17,116. Methods and apparatus for eliminating undesired vibrations of particular frequency. R. A. Fessenden and F. H. Leslie. June 8th, 1917. (129,670.)

17,315. Starting of internal-combustion engines. Vickers, Ltd., and T. S. Duncan. November 23rd, 1917. (129,678.)

17,320. Magnetic deflectors for electric arc in lamps, searchlights, and the like. J. P. Yorke. November 23rd, 1917. (129,680.)

17,674. Sparkgap apparatus for use in wireless telegraphy. A. Marino. November 29th, 1917. (129,700.)

17,689. Mercury vapour lamps. M. J. Cornu. June 5th, 1917. (Addition to 13,807/17.) (129,702.)

17,722. Method of and means for silently operating the vent valves, wireless masts, periscopes, and other appliances of submarines and the like. H. H. Mactaggart and R. G. Scott. November 30th, 1917. (129,703.)

17,762. Submarine signalling apparatus. C. S. Bookwalter and F. S. Doubin. November 30th, 1917. (129,707.)

18,228. Wireless signalling systems. British Thomson-Houston Co. (General Electric Co.) December 8th, 1917. (129,722.)

18,536. Electrodes for arc lamp projectors. Sperry Gyroscope Co. December 18th, 1916. (129,735.)

18,599. Illuminating the dials or scales of clocks and other instruments. J. D. Cooper (legal representative of B. G. Cooper.) December 14th, 1917. (129,736.)

1918.

6,459. Electrodes for spark discharges. R. Bosch Akt-Ges. April 16th, 1917. (115,038.)

8,070. Electric relays. A. C.Heap. May 14th, 1918. (129,751.)

8,164. Electric contacting devices. A. C. Heap. May 15th, 1918. (129,752.)

9,822. Electric furnaces. Morgan Crucible Co. and C. W. Speirs. June 14th, 1918. (129,760.)

10,061. Electrical oil switches. Ferguson, Pailin & Co., S. Ferguson and G. Pailin. June 19th, 1918. (129,763.)

11,231. Instrument for teaching the morse alphabet and for transmitting wireless and other telegraph messages automatically by the morse code. H. H. Ayscough. December 13th, 1918. (129,774.)

11,582. Windings for dynamo electric machines. J. A. Kuyser and British Westinghouse Electric and Manufacturing Co. July 15th, 1918. (129,788.)

11,616. Apparatus for teaching codes as used in telegraphy. C. R. Woodland and R. Woodland. July 16th, 1918. (129,790.)

11,725. Current regulators for alternating current electric circuits. W. Langdon-Davies and A. Soames. July 17th, 1918. (Cognate application 19,675/18.) (129,805.)

12,011. Magneto-operating mechanism. E. C. R. Marks. (Splitdorf Electrical Co.) July 23rd, 1918. (129,820.)

12,063. Railway traffic controlling apparatus. McKenzie Holland and Westinghouse Power Signal Co. August 31st, 1917. (118,611.)

12,313. Control of dynamo electric machinery. J. C. Wilson. July 29th, 1918. (129,828.)

12,924. Transporting magnets. A. West & Co. and F. N. Pickett. August 9th, 1918. (129,841.)

14,040. Electrical cut-outs. A. H. Railing, C. C. Garrard and W. Wilson. August 29th, 1918. (129,853.)

14,322. Welding controllers. Igranic Electric Co. (Cutler Hammer Manufacturing Co.) September 3rd, 1918. (129,858.)

14,523. Adjustable interrupters for ignition dynamos. Splitdorf Electric Co. May 16th, 1918. (119,458.)

15,042. Temperature indicators for electric transformers and the like. British Thomson-Houston Co. (General Electric Co.) September 16th, 1918. (129,866.)

15,672. Incandescent electric lamp holders. Benjamin Electric, Ltd. October 16th, 1917. (120,041.)

15,795. Polishing iron for use with an electric or gas iron in laundry work. J. Bath. September 28th, 1918. (129,876.)

17,342. Turbine and electrical generator plants. W. Chilton and Brush Electrical Engineering Co. October 23rd, 1918. (129,889.)

18,243. Insulating railway rail joints. R. S. Proud. November 7th, 1918. (129,896.)

20,184. Screw nut for securing a shade or gallery on the socket of an incandescent electric lamp fitting. F. G. Flory. December 5th, 1918. (129,910.)

1919.

64. Electro-mechanical transmission systems for automobiles. F. W. Howorth. (M. J. Huggins.) January 2nd, 1919. (129,921.)

2,976. Electric collectors for maintaining contact between relatively movable conductors. A. G. Ionides. February 6th, 1919. (129,934.)

11,437. Joint-making and insulating packing. I. H. Levin. May 22nd, 1917. (Divided application on 8,307/18.) (126,641.)

11,767. Electric heating apparatus. H. J. C. Forrester (H. Burgess). July 10th, 1918. (Divided application on 11,304/18.) (129,959.)